fire like common Salt, nor flash like Saltpetre; but it would melt and swell like alum and borax, as well as ferment with acids; whence it appears to be much of the same nature as pot-ashes.

NITRE of the moderns, commonly called SALTPETRE, is a white crystaline substance, of an acrid bitterish taste, and seemingly a little cold. Its crystals are in the shape of prisms, with six sides, which are slender, long, equally thick, and terminate at each end, like a pyramid with a point. It dissolves readily in water, melts over the fire, and will not flash, unless mixed with sulphur or charcoal; and then it will with great violence. Saltpetre is often seen on old walls that are not washed by the rain, from whence it is taken off with brushes. Artificial Saltpetre is made with earth saturated with common or pigeons dung, whose salts will, in time, be converted into Saltpetre. As Saltpetre cannot be obtained, except from earth impregnated with urinous, animal, or vegetable Salt, some are in doubt whether it is a mineral or animal production; but it is generally reckoned among those that are mineral, because it may be extracted immediately from the earth, and not from any excrements themselves, unless they be mixed with earth.

The spirit of nitre will dissolve silver, whence it is called aqua fortis; and it will communicate the same power to spirit of vitriol and spirit of sulphur. However, aqua fortis will not dissolve gold; for that is only to be done with aqua regia.

NITRE is used in medicine to cool the blood, and to restrain the heat of a fever, to allay thirst, and to hinder putrefaction; for which reason it is commended in malignant cases. It is given from three grains to a scruple, three or four times a day. A drachm given every morning, dissolved in a draught of ale, has been found to cure the dropsy. When Nitre is put into a crucible, and placed over the fire, it will melt like water; and then, if powdered charcoal be thrown into it, it will deflagrate with a noise, which being over more powder must be thrown in, and this must be repeated till the Nitre will flame no longer. By this method, the Nitre will turn into an alkalious salt, which has the same virtue as salt of tartar. Every one knows, that Nitre mixed with due proportions of sulphur and charcoal will make gun-powder.

VITRIOL is either native or factitious, and, with regard to the colour, is distinguished into white, blue and green. White Vitriol is brought from Germany in large lumps, which look almost like loaf sugar, and has a sweetish astringent taste. It is found in mines at Glosslaer in Saxony, where it springs forth from the sides, under the appearance of a woolly substance, which being dissolved in water, must be boiled to a due thickness; and at last, it will turn into a white mass like sugar. Sometimes there are found in the same mines pieces of Vitriol, which are already crystalized and appear transparent.

Blue VITRIOL is dry to the touch, and is formed into blue crystals, like sapphires, of a rhomboidal form, but flat, and with ten sides. It is prepared in various places, but more particularly in Cyprus and Hungary; whence it is commonly called Hungarian and Cyprian Vitriol. It obtains its fine colour from copper, and has an austere taste, with great sharpness.

Green VITRIOL is of an herbaceous colour, and has various names, according to the different places from whence it is got. It abounds with iron from whence it has its colour, and is either in large crystals of a rhomboidal form, or in bits composed of crystaline grains united together, which feel a little oily to the touch; it has a sharp styptic taste.

VITRIOL is nothing else but an acid vitriolic salt, which by corroding zinc, copper, or iron, coagulates with them, and so concretes into a transparent body, which takes its colour from the metal. Blue Vitriol is now got in Hungary from water in the copper mines, near Smolnik and Newsol, by evaporation; and green Vitriol is obtained in Germany after the same manner. But in England, at Deptford, near London, green Vitriol is obtained from a stone, called Pyrites, which is heavy and brown on the outside; and, when broken, there are rays that appear to run from the center to the circumference; and consist of particles that shine like brass, and yet are without any taste. These stones, after they have been exposed to the air for some time, undergo a sort of fermentation, and then crack into clefts, out of which a kind of white down of a saltish nature springs forth, which has an acid styptic taste; at length the whole substance dissolves, and turns into a fine saltish powder, of a vitriolic taste and sulphureous smell. If these stones are calcined in the fire, a copious smoke will exhale from them, with a sulphureous smell, and a red calx will remain behind, containing a little iron and copper.

White VITRIOL is extremely good for making an eye-water, which is, perhaps, the best hitherto known for abating inflammations of the eyes, and to repel fluxions thereon. It is made by dissolving a scruple of vitriol in hot rose water, and then passing it through a linen cloth: a few drops of this is to be put into the eyes. When blue vitriol is calcined, it is very proper for stopping hæmorrhages, by cauterizing the vessels, and condensing the blood therein. Spirit of Vitriol, like other acid spirits, restrains the heat of the humours, stops hæmorrhages, and promotes urine.

ALUM is either native or factitious; but the former sort is now little or not at all known. The factitious is distinguished by the name of the country it comes from, it being of several kinds; for there is scarce a country in which it is not made. One sort is called Rooh, or Rock Alum, because it is sometimes got out of a rock, where it is often met with in very large pieces.

In Yorkshire and Lancashire they get their Alum out of a bluish stone, like slate, that is full of sulphur. It is a sort of Pyrites, which will kindle in the fire, and being exposed to the open air will break of itself. The fragments of these stones are laid in heaps, where they are burnt in the open air; and when the sulphur is quite exhausted, the fire will go out of itself, after which they steep the calcined stones for twenty-four hours in water, when it is drawn off into leaden cauldrons with the lye made with the ashes of a sea-weed. After the liquor begins to boil, they pour urine therein, which causes the sulphur, vitriol, and earthy matter to sink to the bottom. This done they take the liquor and pour it into vessels made with deal boards, where, in time, the Alum concretes to the sides, in white transparent crystals, which, after washing, are melted in iron cauldrons; after this it is poured into a tub, and forms a mass of the same size. However, in different countries, they have different methods of making Alum, which would be tedious, as well as useless, to relate.

Alum is of a very binding nature, and has always been looked upon as a great styptic. That of the ancients had a smell like aqua-fortis, but the factitious has none at all; and, when placed over the fire in an iron pan, it bubbles up and melts like water. When Alum is set to crystalize, it concretes into a figure with eight sides, which looks like a triangular pyramid, with the angles cut off; insomuch that it is composed of four hexagon surfaces, and four that are triangular. From a chemical analysis it appears, that Alum consists of an acid vitriolic salt, and an astringent earth or bole intimately united. Alum is recommended for swellings of the gums, and against the fluxions upon the tonsils. When burnt, it

it will take down proud fleſh in wounds and ulcers; it is of no uſe internally, only it is ſometimes given with a large portion of nutmeg for the cure of the ague.

SAL-AMMONIAC, of the ancients, was a ſort of foſſile Salt or Sal-gem, though Dioſcorides would have it to be a kind of common Salt, which is denſe, tranſparent, white, eaſily cloven, and dug out of the earth; all which have the properties of Sal-Gem; for it will readily cleave into plates.

Factitious SAL-AMMONIAC is of two ſorts, one of which is brought from the Eaſt Indies in conical pieces like ſugar loaves, of an aſh colour; but this is very ſcarce. The other and common ſort is brought from Egypt and Syria in flat cakes, convex on the upper part with a ſort of a navel, and a little hollow on the other; they are about a palm in breadth, and three or four inches thick, of an aſh colour without, and whitiſh within.

SAL-AMMONIAC is a very uſeful medicine, for it diſſolves thick clammy humours, and carries them off by ſweat and urine. Some commend it in agues, given to the quantity of half a drachm, with a ſcruple of crabs eyes before the fit. The Volatile Salt and ſpirit of Sal-Ammoniac are good in a lethargy, apoplexy, fainting, giddineſs of the head, and hyſteric fits, being held to the noſe. Internally, the ſpirit promotes a diaphoreſis, ſweat and urine; it blunts acid humours in the body, promotes the circulation of the blood, refreſhes the ſpirits, excites the oſcillations of the nerves, and opens obſtructions. Whence it is good in the apoplexy, epilepſy, lethargy, ſleepy diſeaſes, and in hyſteric fits. It may be given from ſix drops to a drachm in any proper liquor.

BORAX is of two ſorts, the one native, and the other refined. Native Borax is brought to us in bits of the ſize of large hazel nuts, and of a dark green colour, covered with a ſort of earthy fat matter. It is found in various places, and is brought from the empire of the great mogul, and from Perſia, where it is found in mines of metal, eſpecially thoſe of copper, from whence proceeds a ſaltiſh, muddy, greeniſh water, which is carefully catched, and being evaporated into a proper thickneſs, is afterwards poured into pits lined with a paſte, made with the mud of theſe ſprings, and the fat of animals, which are alſo covered with the ſame paſte. After ſome months they are opened, and find the water concreted into ſtones. When Borax is purified, it appears clean, white and tranſparent, ſomewhat like the cryſtals of Alum, with a ſlight ſaltiſh taſte, and a lixivious ſharpneſs. It is of the ſame ſubſtance with the native, and was formerly brought from Venice. It is imported to us from the Eaſt Indies, and principally from Bengal. When Borax is placed over the fire, it ſwells like Alum, and at length melts into a hard tranſparent maſs, reſembling glaſs, which, however, will diſſolve in water. After examination, it appears that Borax is a ſort of a fixed Salt not unlike that of Tartar; but differs from it in joining with acid Salts, without any effervеſcence. Borax is uſed by goldſmiths for ſoldering gold, and to render the melting of metals more eaſy; likewiſe, it is employed by ſome dyers to give a gloſs to their ſilks.

CHAP. XIX.

Of SULPHURS, BITUMENS and COALS.

COMMON SULPHUR, or BRIMSTONE, is either native or factitious, or rather depurated. Native Sulphur, commonly called Sulphur Vivum, is either tranſparent or opaque; the tranſparent appears like a gem of a gold colour, though ſome is met with that is yellowiſh or greeniſh. It is found in the gold mines of Peru, particularly in Quito, on the iſland of Milo, in the Archipelago, and in the canton of Bern, in Swiſſerland. The opaque is uſually met with in hard ſolid maſſes of a greeniſh ſhining colour, or under the form of an aſh coloured clayey glebe, inclining to yellow. It is in the greateſt plenty at the feet of the mountains that throw out fire and ſmoke, ſuch as Veſuvius, Etna, Hecla, and the like; as alſo in ſome parts of Europe and America, where there are ſulphureous earths or fountains.

Factitious SULPHUR is prepared ſeveral ways; for in ſome places it is boiled in water, as at Buda in Lower-Hungary. At Aix la Chapelle, in the hot baths, Sulphur is raiſed in vapours from the water, and ſticks to the cover of the ſpring in hardiſh lumps, that have the appearance of flower of Sulphur, and a great quantity of this is gathered every year. Sometimes it is extracted from a whitiſh clayey earth; and is as often obtained from the ſtone called the Pyrites, particularly in the dioceſe of Liege, where they are found like lead ore.

ORPIMENT is an arſenical juice, compacted into glebes, conſiſting of thin ſcales or leaves, almoſt like Iſing-glaſs, which may be eaſily ſeparated from each other. There are three kinds, one of which ſhines like gold, another is reddiſh mixed with a citrine colour; the third is greeniſh and mixed with earth; but the firſt is beſt. They are found in mines of gold, ſilver, and copper.

ORPIMENT has a ſharpiſh taſte, will diſſolve in oil, readily take fire, and emit a copious fume, between the ſmell of ſulphur and garlick. By the heat of the fire it will diſpenſe in plentiful fumes, which if collected, concrete in yellowiſh flowers, like ſulphur; and at the bottom of the veſſel there will remain a blood-coloured melted maſs, which, when cold, becomes thick and ſolid, like cinnabar. This, by ſome, is called red Orpiment, or Realgar. If this maſs be kept longer over the fire, in a ſublimating veſſel, it will riſe to the upper part, and there concrete into a tranſparent, red, elegant ſubſtance, like a ruby; but at the bottom there will remain a little metallick earth.

Hence it is plain, that Orpiment conſiſts of the ſame principles as common Sulphur, only it is mixed with ſome mercurial particles. Some take it to be of a very poiſonous nature; but Hoffman, after many experiments, by giving it to dogs, has found that it is intirely innocent. It is made uſe of by ſome barbers, mixed with lime, to take off the hair where it is ſuperfluous; but if it lies on long, it will corrode the ſkin, which doubtleſs is owing to the lime.

REALGAR, called ZARNICK by ſome, is, by others, named Red Orpiment. It is of two kinds; that is, native and factitious. The native, which is got out of mines, is of the colour of cinnabar, and ſmells like a mixture of ſulphur and garlick when it is burnt. The factitious is made with Orpiment in ſublimating veſſels; for the yellow part will riſe towards the top, and the maſs that remains at the bottom is the Realgar. However, we are not to confound this with the red factitious Arſenick hereafter deſcribed.

Realgar is brought into Europe from China, in ſeveral ſhapes, which they call Pagods, theſe ſeem to be made by melting, not carving. Some antient phyſicians have given this inwardly; the natives of the Eaſt Indies make cups herewith, and the water poured therein, after ſome time, is uſed as an excellent remedy againſt ſeveral diſeaſes. Some think that it would not have the like effect on European bodies; for they ſuppoſe the nature of man in the Eaſt Indies and ours to be greatly different; but this is a miſtake. However, it is uncertain whether

Realgar

Realgar be as innocent as Orpiment, or not; but that it is not poiſon is certain, for Hoffman gave two ſcruples of it to a dog, without the leaſt bad conſequence, and he was as well afterwards, as if he had taken nothing; but this is not the caſe with the flowers of Orpiment, for a ſcruple of theſe being given, it excited enormous vomiting; however, it did not kill, but if the flowers are obtained another way, that is, by mixing four ounces of Orpiment with three ounces of oil of Vitriol, they will yield an ounce of the flowers adhering to the neck of the retort, which are entirely innocent; for they are almoſt taſteleſs and promote ſweat more powerfully, perhaps, than any other medicine.

ARSENICK, properly ſo called, is in Bohemia and Saxony extracted from a mineral called cobalt. If this be mixed with calcined flints and pot-aſhes, the mixture, in a very ſtrong fire, will turn into a glaſs of a bluiſh colour, that when reduced to powder is called ſmalt. In the preparation of this glaſs a copious ſmoke is exhaled, or rather flowers, which ſticking to the ſides of the furnace, and collected together, appear in the form of a white powder, which put into a crucible, and melted in an exceeding ſtrong fire, turns into a white, heavy, hard, glaſſy maſs; and this is named white Arſenick, which is a moſt dangerous poiſon. But when to ten parts of the former powder, one of ſulphur is added, and melted, as before, then yellow Arſenick will be produced. Again, if two parts of the ſulphur are added to ten of the powder and melted, as before, it will turn to a reddiſh maſs, which goes by the name of red Arſenick.

COBALT itſelf is a foſſile body, which is heavy, hard, and almoſt black, not very unlike antimony; it has a ſulphureous, nauſeous ſmell, when kindled in the fire, and is commonly mixed with a portion of braſs, and ſometimes of a little ſilver. Cobalt is found in ſome parts of England, and particularly in Mendip hills in Somerſetſhire; but ſome think it is not ſo good as that of Saxony.

NAPHTHA, or PETROLEUM, is a mineral oil of a bituminous nature, which is inflammable, and has a fragrant ſmell. It is of ſeveral colours, as white, yellow, red, and blackiſh. There is ſcarce any country where this bitumen is not to be found; but in the iſland of Sumatra there is an excellent ſort, which by the inhabitants is called *miniac tanna*, which ſignifies oil of earth; and this is in high eſteem in the Eaſt Indies. The Italians are laviſh in their praiſes of the Petroleum found in Modena, and obtained from certain ſprings and wells. The earth of this dutchy abounds therewith; but that is moſt remarkable which is met with in the place called Il Fumento, where there is a well near forty yards deep, whoſe water is mixed with this oil. Twelve miles from Modena there is a noted rock, where there is a ſpring, on whoſe water a yellowiſh oil is ſeen ſwimming; and this will produce about twelve pounds of this oil in a week.

Petroleum readily flames, for which reaſon, in many places, it is uſed for lamp oil. It conſiſts of fine volatile parts, upon which account, if a candle be held over the wells or fountains that yield this oil, the vapours will readily take fire. It is difficult to unite ſpirit of wine with Petroleum, it being of ſuch a fat conſiſtence. That Petroleum is generally counted beſt which is freſh, white, tranſparent, and has a ſubtile bituminous ſmell; the next in eſteem is the yellow, then the red, but the black is worſt of all. A few drops of this oil is given to children to kill worms; and it is uſed outwardly in the palſy, and for cold pains of the nervous parts.

Mineral PITCH is a kind of reddiſh or blackiſh bitumen, having a fragrant bituminous ſmell. It is of a middle conſiſtence between petroleum and bitumen, and is not unlike tar. It grows more fluid in heat, and thicker with cold; and it emits a flame when kindled. It is by ſome authors called Piſſaſphaltum, and ſprings out of the earth in ſeveral places between the chinks of ſtones. That at Caſtro near Rome riſes through the clefts of ſtones, chiefly in the ſummer time, of the conſiſtence of honey, and is of a black colour and a moſt ſubtile ſmell. In Auvergne in France there is a plentiful ſpring of this bitumen, which has the appearance of tar, it being black; but if it be kept a conſiderable time, it will grow harder, but not ſo hard as pitch. That moſt common in England is Barbadoes tar, which is a liquid bitumen, and is uſed externally, for all pains proceeding from a cold cauſe; as well as numbneſs, cramps, and palſies. It is given, inwardly, in pretty large doſes, for the dry belly-ach.

Jews PITCH is a ſort of bitumen, which is ſolid, brittle, heavy, of a reddiſh black, ſhining, and inflammable, with a ſtrong bituminous ſmell, eſpecially when it is melted over the fire. It is found in ſeveral places, and particularly in Judea, from whence it has its name. It is found ſwimming on the top of the Dead-Sea, and is, at firſt, ſoft, thick, and may be readily pulled in pieces; but, by length of time, it becomes harder than common pitch; it is known in the ſhops by the name of Aſphaltum. The true ſort is ſeldom brought to us; for what we have is entirely black; only when it is broken, it has a ſaffron colour caſt.

AMBERGREASE is of an aſh colour, or grey, and is a fat ſolid ſubſtance, like ſuet, but light. It is variegated like marble, and is ſometimes ſpeckled with white; it ſprings from the bowels of the earth, is condenſed in the ſea, and is found floating on the water, though ſometimes it has been met with on the ſea ſhore, where it has been thrown by the waves. It is ſometimes black as well as grey; but the grey is accounted beſt. There is little room to doubt that this is a ſort of bitumen, which proceeds from the earth near the bottom of the ſea; for it ſometimes contains ſtones, ſhells, the bones of animals, and the bills and claws of birds, as well as honey-combs, from which the honey has not been all loſt. Hence it appears, that this bitumen muſt have been firſt in a liquid ſtate; it has been ſometimes found in lumps of above two hundred pounds weight. A great deal of this is got in the Indian ocean, about the Molucca iſlands; though it has alſo been found near Africa, and ſometimes near the northern parts of England, Scotland, and Norway.

Ambergreaſe will readily melt in the fire into a ſort of gold coloured roſin, which will kindle and burn when held to a candle. It will not diſſolve entirely in ſpirit of wine, but leaves a black pitchy matter behind it. The ſolution, after ſome time, will depoſit a white cloudy ſediment, which will coagulate by little and little, and grow thick, eſpecially by the evaporation of the finer parts of the ſpirits of wine; this being dried becomes a ſhining ſort of earth, not much unlike ſperma-ceti. It conſiſts of oily greyiſh particles, which are very fine and volatile, with others that are thicker, ſaline, and bituminous. Ambergreaſe is of great uſe among perfumers, and is recommended by phyſicians for raiſing languiſhing ſpirits, and increaſing their motion; whence it is given for diſorders of the brain and heart, as well as in fainting fits. The doſe in ſubſtance is a pill of the ſize of a ſmall pea, or from one grain to eight in a poached egg or wine.

AMBER is a hard bituminous ſubſtance, brittle, ſomewhat tranſparent, and of a yellow or citrine colour, though ſometimes it is whitiſh and ſometimes brown. The taſte is ſomewhat acrid and bituminous, with a little aſtringency; the ſmell, when warm, is fragrant and bituminous; and when rubbed it will attract ſtraws and bits of ſticks by its electrical

electrical virtue. It is found in large quantities in Pruſſia, which is the country where it is chiefly got, particularly in the Baltick ſea, near the ſhore of Sudavia, where it is found ſwimming upon the water, and is taken in nets. However, this bitumen is not a production of the ſea; for its water only ſerves to waſh it off from the bowels of the earth, and remove it to places near the ſhore. The veins of this bitumen have been found, by the order of the king of Pruſſia. In digging for them they firſt met with ſand, which being taken away, a ſtratum of clay appeared, and ſtill deeper there was another like old wood, under which there was the mineral of vitriol, which being expoſed to the open air, it was covered with an efflorescence of green vitriol. Still deeper there was a ſandy mineral, out of which, with proper inſtruments, they got Amber in various places. By this means, in the March near Kuſtrin, as alſo in the Tract of Stolpen and Dantzick, it was met with among ſand, and found collected in heaps; whence it appears they were greatly miſtaken, who took it for the roſin of trees that dropt from them into the ſea. It ſeems to proceed from the bituminous foſſile wood, juſt mentioned, by the aſſiſtance of the ſubterranean heat; which, at firſt, is probably like Petroleum, and after paſſing through the mineral of vitriol, by the mixing therewith, becomes coagulated into a hard body. There is no doubt that it has been liquid, becauſe it is often found in a round form, containing ſeveral ſorts of inſects therein; beſides, the oil which is obtained from Amber, is, for virtue and ſmell, like Petroleum. Charlton, who was a very great naturaliſt, has ſometimes found real Petroleum included in pieces of Amber, which is a farther reaſon to prove what is aſſerted. The greateſt plenty of this bitumen is found near the ſhore of Sudavia, after a violent north wind, attended with a tempeſt. Sometimes Amber is ſo tranſparent, as to ſerve to make burning glaſſes, one of which is kept in the cabinet of the Landgrave of Heſſe-Caſſel. Amber, properly prepared, becomes a medicine for opening the obſtructions of the bowels, and promoting all ſorts of excretions; and conſequently is a very uſeful remedy in chronical diſeaſes. It is likewiſe ſaid to be very efficacious in curing cold diſorders of the brain, and particularly in pains of the head, ſleepy and convulſive diſeaſes, as well as in hyſteric and hypochondriac fits. The doſe is from a ſcruple to a drachm in a poached egg, or any other proper vehicle. The volatile ſalt of Amber is diuretick, and accounted a ſpecific in hyſteric and convulſive diſeaſes. The doſe is from ten grains to thirty. The oil is commended in nervous diſorders, particularly in the gout, palſy, and catarrhs, by anointing the parts therewith. It is given inwardly from two to twenty drops.

JET, called by ſome Black Amber, is a bituminous ſubſtance, dry, hard, black, ſmooth and ſhining, and being ſet on fire turns almoſt like pitch, emitting a thick black ſmoke, with a bituminous ſmell. It differs very little from pit-coal, eſpecially the finer ſort, which we call Kannel coal, if it be not the very ſame. It differs from a bitumen in not melting as that will do, and when diſtilled it yields a ſharpiſh acid phlegm, and then a black oil; but laſt of all a ſubſtance like butter, or thick oil. It leaves behind it a very black caput mortuum.

PIT-COAL is univerſally known in theſe parts, and when diſtilled in a retort, firſt yields a phlegm, then a ſulphureous ſpirit that is a little acrid, which is afterwards ſucceeded by a ſubtile oil, and then one that is thick, which ſinks to the bottom. With the greateſt degree of fire there is produced a ſort of an acid ſalt, like that of Amber, leaving behind it a light black earth. When the ſpirit is thrown on quick lime, it becomes volatile, and ſtrikes the noſe with a ſtrong ſmell; ſpirit of nitre being added to this, a white ſmoke will ariſe, which yields a very pleaſant ſight. The fœtid oil being mixed with ſalt of tartar, has the ſmell of a volatile ſalt, and when this mixture is diſtilled, it yields an alkaline, volatile, oleous ſpirit, which will turn ſyrup of violets green; but if it be mixed with an acid, it will immediately ferment, and become of a bright red colour. The thick oil of coals has a ſulphureous ſmell, and being put into a ſilver ſpoon, with a gentle heat, will turn it blackiſh, which is a certain ſign there is a true mineral ſulphur contained therein, for common ſulphur, diſſolved in oil of turpentine, will do the ſame. Hence it is plain, that coals contain nothing that is unwholeſome; nor is there any arſenick at all in them, though ſome have ſuppoſed the contrary. Nor yet is the mineral ſulphur which they contain ſo hurtful as ſome have imagined; for thoſe that are employed in the melting and preparing ſulphur are as well, and in as good caſe as other people, and much better than miners of other kinds. Coals are ſo far from doing any harm, that they are rather beneficial, by drying up the too great humidity of the blood, and preſerving the body from putrefaction; for it has been obſerved by Galen, that all bitumens, being kindled, mend the diſorders of the air, by diſperſing their too great humidity; which opinion has been hitherto followed by all phyſicians. Where the atmoſphere is very moiſt, and full of watery vapours, ſo hurtful to human bodies, the burning of Coals is certainly very proper. In former times, when the plague and other infectious diſeaſes were common, they uſed to burn bitumen to purify the air; and this is certain, that in London, ſince the burning of Pit-Coal has been almoſt univerſal, no plague has ever affected that city, nor any diſeaſe of that kind; and therefore there is no reaſon to be afraid of it, unleſs it be brought from other countries.

There are mines of Coals dug in various parts of England, which generally differ, in ſome reſpect, from each other; thoſe brought from Newcaſtle, improperly called Sea-Coal, are remarkable for their being generally ſmall, and caking on the fire. Theſe are the beſt for boiling fleſh, which others, in various parts of the kingdom, will not do, particularly in Staffordſhire. Kannel Coal, which is dug up in Derbyſhire and other places, is famous for its fineneſs, as well as hardneſs, though it will burn like a candle; there are now ſeveral things made with it, ſuch as the tops of ſnuff-boxes, ſalt-cellars, and the like. It is alſo found in Staffordſhire, and it is remarkable, that the choir of the cathedral church of Litchfield is paved therewith; that is, the black part with Coal, and the white with alabaſter, which look like black and white marble. It will turn like ivory, into ink-pots and candleſticks; and ſome have their coats of arms carved thereon. The other Coals moſt uſed in London are brought from Wales and Scotland, and are valued for burning clear without a great deal of ſmoke.

CHAP. XX.

Of METALS and SEMI-METALS.

ANTIMONY is a mineral, conſiſting of ſulphur and a mercurial arſenical ſubſtance, as is univerſally allowed by the chemiſts. It is ſolid, heavy, brittle, of the colour of lead, conſiſting of long ſhining ſtreaks, and will melt in the fire, but is not malleable, in which it differs from a metal properly ſo called. There are ſeveral kinds of it, one of which looks like poliſhed lead; but it is brittle, and mixed with a ſort of cryſtaline ſtone. Another conſiſts of ſlender ſhining lines, that look like needles placed

placed in rows, in ſome places, and in others without any order. A third kind is made up of broader ſhining plates; and a fourth of ſmall lead coloured rods, which melts in the fire as readily as ſulphur, on account of the large quantity of that ſubſtance contained therein: this is found in Italy, near Maſſa in Tuſcany. There is ſtill another kind, which may be diſtinguiſhed by ſaffron coloured, or reddiſh ſpots diſperſed here and there; and this is met with in the gold mines of Hungary. In ſhort, there is ſcarce any part of the world where this mineral is not to be found, and though they ſeem to be of ſo many different ſorts, yet their natures are nearly the ſame.

The Glebe of Antimony is generally mixed with a ſtony ſubſtance, which it is freed from by melting. They firſt break it into bits, and place it over the fire in earthen veſſels, with holes at the bottom, under which there is another earthen veſſel in the form of a cone, and when it is in fuſion it runs through the holes, and leaves the droſs behind. That which is hard, heavy, of a lead colour, with ſhining ſtreaks, placed like rays, is accounted the beſt, and the Hungarian Antimony, for this reaſon, is choſen for medicinal purpoſes. The ſulphur in Antimony may be readily perceived, not only from the ſmell, but from the bluiſh flame it emits while it is melting. Beſides, when nitre is thrown into the crucible, containing red hot Antimony, it flaſhes in the ſame manner as with common ſulphur.

It was formerly thought, that the ſulphur of Antimony partook of the nature of gold; for which reaſon they employed themſelves to little purpoſe in making experiments to extract the fine ſulphur therefrom. Notwithſtanding this, it is now generally acknowledged, that the ſulphur of Antimony is exactly of the ſame nature as common ſulphur, though all the reguline parts are ſeldom extracted from it; nor yet can that be called the pure ſulphur that riſes in flowers, when ſublimed; for, though it takes fire like ſulphur, yet the fume is of a whitiſh-yellow like that of orpiment. Beſides, that it is not pure, may be known by its effects; for it will occaſion violent vomiting, which is a certain ſign that it is not entirely freed from the reguline particles. If you take white arſenick and mix it with half ſulphur vivum, and afterwards ſublime the maſs, there will ariſe reddiſh flowers, which, when taken inwardly, have a very violent operation, and when they are ſet on fire emit a reddiſh fume; for there is ſuch a force in mineral ſulphur, that it will readily join with the arſenical particles, and carry them up therewith, when ſublimed.

There is no ſubſtance in the world that yields ſo powerful a poiſon, and ſuch efficacious medicines, as Antimony; however, when crude, it has no violent operation, and yet, taken in a proper quantity, may be given very advantageouſly in many caſes, both to men and cattle. But if crude Antimony be melted in the fire, and mixed with the like quantity of nitre, by little and little it turns to a poiſon; and yet, if Antimony is mixed with one part of common ſalt, and calcined over a gentle fire for ſome hours, continually ſtirring it with a ſpatula, and afterwards edulcorating with water, there will remain an aſh-coloured powder, which has no violent operation, but will promote a gentle ſweat. Moreover, if you take four parts of Antimony, and four of ſalt of tartar, and melt them, and then pour them into a cone proper for that purpoſe, you will have the medicinal regulus of Antimony, which may be beaten into a reddiſh powder of extraordinary virtue. But if, inſtead of one part of the ſalt of tartar, two or three be made uſe of, and then melted, the regulus will be changed to a poiſon, which is occaſioned by its being deprived of too much of its ſulphur.

Crude Antimony, reduced to a fine powder, and taken inwardly, is very uſeful in ſeveral diſeaſes; for it will diſſolve the clamminеſs of the fluids, open obſtructions, and is a good remedy in diſeaſes of the ſkin. It is alſo excellent againſt the rheumatiſm, and will take away numbneſs of the limbs. The doſe is about half a drachm. Antimony is alſo uſeful to various artificers; for pewterers mix it with tin and lead to make their pewter ſhine, and to give it the ſound of ſilver; bell-founders mix it with other metals in making their bells; likewiſe the letter-founders conſtantly employ it in making their types. Add to this, that goldſmiths make uſe of it in purifying gold; for, when melted therewith, it will deſtroy all other metals, not excepting ſilver, and turn them into droſs.

BISMUTH is a ſemi-metal, which will melt in the fire, but is not ductile; it is heavy, brittle, and differs from lead and tin in its colour and hardneſs; for it ſometimes looks like ſilver, and ſometimes is of a faint purple colour, not unlike regulus of antimony, though it conſiſts of broader plates. Biſmuth is ſometimes found in ſo very pure an ore, that it ſtands in need of no other operation to fetch it out, than by breaking it in pieces. In the Muſæum of the Royal Society there are pieces of Biſmuth ſent from Cornwal under various names, which are ſo very rich, that, if a piece of it be only held with a pair of tongs againſt a clear fire, the Biſmuth will run down in the form of melted tin, almoſt as ſoon as cheeſe will drop in toaſting. Some call the ore of Biſmuth the cobalt of Biſmuth; becauſe it contains the ſame principles as real cobalt, only in a different proportion. It is by ſome called tin-glaſs; and, when broken, appears to conſiſt of ſmall cubic particles, and theſe again of minute plates applied to each other. It is more brittle than zinc, though it differs little from it in external appearance, except in colour. It will cauſe metals, that will not eaſily melt, to be more fuſible by a much leſs fire than they otherwiſe would. It mixes eaſily with any metal, and, according to the greater or leſs quantity added thereto, it renders them more or leſs white and brittle. But as Biſmuth is eaſily deſtroyed, its mixture with metals, difficult to be melted, ſhould be made in cloſe veſſels. It is very obſervable, that Biſmuth melted with lead, tin, or ſilver, and afterwards amalgamated with Mercury, will paſs through leather in much greater quantities than they otherwiſe would. When this powder is waſhed it is very white, and uſed by the ladies as a beautifier of the ſkin. It is of little uſe in medicine.

ZINC is a ſemi-metal, of a blueiſh-white colour, brittle, and yet ſomewhat ductile and malleable, though much leſs ſo than metals. It melts in a gentle fire, after which it ſmokes, and then ſticks to the furnace in the form of exceeding white flowers. In a greater fire it burns, and emits a flame of a moſt beautiful green colour. All the Zinc that is prepared in Germany, eſpecially at Goſslaer, is obtained by ſublimation, and not by melting; nor is it got out of any ſingle ore, but out of ſuch a confuſed mixture of different ores, that ſeveral other metals and ſemi-metals may be ſeparated therefrom at the ſame time. There is no particular kind of ſublimation for the extracting of Zinc; for it is collected during the melting of other metals, eſpecially lead. The ores that yield Zinc are, by long and repeated roaſtings, freed from ſulphur, and in a manner from arſenic, by the ſame operation.

There are certain ſubſtances that may be more properly called ores of Zinc, ſuch as lapis calaminaris, or calamine; as alſo native cadmia. This is of a very irregular figure, ſometimes ſpongy, and now and then ſolid. It is ſometimes of a gold colour, ſometimes red, and at other times grey; or of

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the mixture of them all. It is not very heavy nor hard; and, when broken in pieces, it immediately emits a flame of a greeniſh colour, and exhales a white, thick, copious fume, of a ſmell peculiar to itſelf, which condenſes into very light flowers, at firſt bluiſh, and then of a greyiſh white. But care muſt be taken that the calamine be not mixed with a yellow ſulphureous pyrites, or the white arſenical one, nor yet with lead ore.

Zinc, by ſome called Spelter, and by others Tuttenag, mixes readily with lead and tin, rendering them more brittle and leſs malleable. When it is by fuſion mixed with four times the quantity of copper, it becomes a brittle metal of a gold colour, which is well known by the name of Prince's or Bath metal. The white flowers of Zinc, taken internally, promote ſweating, and ſometimes they will work upward and downward. The doſe is from four grains to twelve. The making of Prince's metal is by melting three ounces of copper with half an ounce of Zinc, and when the maſs is cold, it will appear of a fine gold colour, remaining ductile with a hammer.

COBALT is a ponderous mineral finely ſtreaked, or ſometimes granulated. It is often ſmooth on the outſide, of a light greyiſh, and almoſt ſemi-metallick colour, and ſometimes of a dark blackiſh dye. It contains a great deal of arſenick, as well as a certain fixed earth, which being melted with flints, and fixed ſalts, turns into a glaſs of a fine blue, called Smalt, which has been taken notice of before. Cobalt commonly contains biſmuth; however, there are ſeveral minerals which go by the name of Cobalt, that have different properties from the former. That called the flower of Cobalt is finely ſtreaked, lighter than the foregoing, and of a fine red purple colour, and belongs to this claſs; for it is a very arſenical mineral, and loſes one half of its weight in the fire; but a great deal of biſmuth may afterwards be melted out of what remains. This will likewiſe give a blue colour to glaſs, like the other Cobalt.

Native CINNABAR is a foſſile metallick ſubſtance, heavy, but not very hard, which is either found pure, or mixed with ſtones. One of the ſorts, when pure, is of a purple colour, inclining to red, and when ground, becomes of a beautiful red. There is another of a blackiſh, or of a liver colour, like blood-ſtone, and another yellowiſh. That ſort of Cinnabar, which is mixed with ſtones, is often found in a fiſſile aſh coloured ſtone, and ſometimes in a very white metallick ſtone. It is ſometimes met with under the form of pyrites, of a gold or ſilver colour. It is found in various places, as in Carinthia, Hungary, Bohemia, Italy, Spain and France.

It is known almoſt to every one, that it contains plenty of quick-ſilver, which is got from it by diſtillation, with the aſſiſtance of quick-lime or filings of iron. Sulphur may be extracted from it, though in a ſmall quantity, if it be boiled in a ſtrong lye, and ſeparated from the quick-ſilver by pouring diſtilled vinegar thereon. Beſides, Cinnabar may be made by art, not much unlike the native, as will be taken notice of hereafter. It is recommended by ſome phyſicians for internal uſe againſt the epilepſy, vertigo, madneſs, and diſorders of the head; but the native Cinnabar is now very little uſed, the factitious ſort being preferred.

QUICK-SILVER, or MERCURY, is a metallick fluid ſubſtance, cold to the touch, of a ſhining ſilver colour, very heavy and volatile, and readily mixes with moſt other metals. It is either found fluid in the bowels of the earth, in the chinks and veins of mines from whence it is collected, and waſhed with plenty of water to ſeparate it from the earth, or it is dug up in glebes, conſiſting of a red mineral, ſulphureous, mercurial ſubſtance, called cinnabar. It is alſo found in the form of a ſlimy or ſtony glebe of divers colours, it being ſometimes red, yellowiſh, brown, or of a lead colour. From this laſt, Quick-ſilver may be obtained by ſimple diſtillation, without the addition of any other matter, either by aſcent in a retort, with a proper fire; or by deſcent, which is the common way, and is done in the following manner: They pound the mineral, and throw it into earthen veſſels with a narrow neck, ſtopping it up with freſh moſs from trees; then they place another over it, with a wider mouth, and bury them in the earth, with one of the mouths againſt the other, coating them all round with clay, and luting the mouths together, in ſuch a manner, that the empty veſſel is entirely hid under the earth, and that which is full placed above it. This is done in an open place, and many of them ranged in rows, after which they make fires all round them, by which means the minerals are heated, and the Quick-ſilver falls by drops into the lower veſſel; but if the mineral abounds with ſulphur, the Quick-ſilver cannot be extracted without the addition of ſome other ſubſtance, ſuch as quick-lime and filings of iron, already taken notice of, as alſo wood-aſhes.

Quick-ſilver exceeds all other metals in weight, except gold; for that will ſink therein, while others ſwim at the top. The weight of gold, compared with Quick-ſilver, is a little more than four to three. It will mix with all metals, or ſemi-metals, though not without difficulty, with antimony, iron, and copper. It penetrates the metals, renders them brittle, and diſſolves them; for which reaſon it is accounted by ſome the firſt matter of metals; but this opinion cannot be ſupported by experiments. It may be made to put on various appearances, which are all reducible to running Quick-ſilver again. It joins very readily with ſea-ſalt, and turns therewith, by a gentle heat, into a white cryſtaline maſs, called corroſive Mercury ſublimate; but it will not do the ſame with nitre and vitriol. It will readily diſſolve in ſpirit of nitre; but not without great difficulty with the oil of vitriol. It undergoes no change with alkaline ſalts; but it may be killed and fixed with ſalino-ſulphureous bodies. Being ground ſome time with ſulphur, it will turn into a very black powder, called Æthiops mineral; which, by the aſſiſtance of fire, may be ſublimated into a very red radiated ſhining maſs. Quick-ſilver being diſſolved in ſpirit of nitre, and the acid ſpirit exhaled by fire, a red powder will remain at the bottom, called red precipitate; but if it be precipitated with ſalt of tartar, a brown powder will fall to the bottom, named precipitate of Wurtz; but with ſea ſalt it will be white, and with lime water yellow.

The analyſis of Quick-ſilver is very difficult, becauſe it frequently flies away with the heat of the fire; however, if it be expoſed to that heat in a glaſs veſſel, with a long neck, it will, at length, become a grey powder, then yellow, and, at laſt, red; at which time it is ſomewhat more heavy than when fluid. But if this be expoſed to a more violent heat, it will fly away, leaving only a little brown earth behind it.

Quick-ſilver, by the ancients, was accounted a poiſon, and Avicenna was the firſt who ventured to uſe it externally; but upwards of two hundred years ago ſome had the courage to uſe it internally, becauſe they obſerved that it did ſheep no harm, when it was given them by their ſhepherds to kill their worms. But Quick-ſilver cannot be ſaid to have no bad effects; for thoſe that are employed in digging for it, ſeldom continue four years without being affected with a trembling of the limbs and a palſy, of which they die.

However, Quick-ſilver has a remarkable virtue in opening all obſtructions of the veſſels and glands,

and of diſſolving the thick groſs matter contained therein, for which reaſon it is given in ſchirroſities of the liver, ſpleen, and meſentery, as well as in obſtructions of the glands, and will alſo temperate the acrimony of the blood and humours. Quick-ſilver, not only taken inwardly, but applied outwardly in an ointment, will purge the body by ſtool, ſweat and inſenſible perſpiration; but its moſt remarkable effect is that of ſalivation.

That Quick-ſilver is counted beſt that is of a ſhining ſilver colour, very fluid, and, when held over the fire in a ſilver ſpoon, will fly away, without leaving any thing behind it. That which is of a livid colour, and does not ſeparate into drops that are exactly round, is naught, and ſhews that it has been adulterated with lead or biſmuth. However, it ought always to be cleanſed, which may be done by ſqueezing it through ſhammy leather; but the beſt way is to diſtil it in a retort with quick-lime, pot-aſhes, or iron filings. Crude Quick-ſilver may be given to kill worms, from a ſcruple to a drachm; and it may be rubbed on glaſs with ſugar till it is diſſolved, if a drop or two of oil of ſweet almonds be added thereto. A pound of Quick-ſilver may be alſo boiled in pure water for an hour, and ſome of the clear liquor given to children for their common drink. It will kill worms taken inwardly, and lice when applied outwardly with an ointment. Crude Quick-ſilver is ſometimes given to the quantity of two or three pounds, with oil, to force a paſſage through the guts in the iliack paſſion.

LEAD is of the leaſt value of all metals, it being heavy, livid, and fouls the hand with a blackiſh colour; it yields little or no ſound, and melts quickly in the fire before it turns red. Pure Lead is ſeldom found in the mines, but is extracted from ores of different kinds; for it is ſometimes black, blue, yellow, or of an aſh colour. It is ſometimes full of ſhining minute particles, and ſometimes again it is like a ſtone of a leaden ſhining colour, conſiſting of ſquares like dice, that lie in a white or reddiſh ſtone. The ore of Lead almoſt always contains a ſmall quantity of ſilver; and particularly that of Cardiganſhire in Wales has ſo much of it, that from two thouſand pounds weight of ore, there has ſometimes been extracted twenty pounds of ſilver.

When flints and the like are mixed with an aſh or black colour, or are only marked here and there with veins and ſpots of the ſame, it is a ſign that they contain either Iron or Lead. The green Lead ore is very rare; but when it is found it is variegated with a yellowiſh green colour and ſemi-tranſparent. It is likewiſe heavy but not hard, and one hundred weight of it yields from ſeventy to eighty pounds of Lead. There is alſo white and aſh coloured Lead ore, but it is as uncommon as this.

There are ſeveral mines of Lead in Spain, Italy and Germany; nor is France without, though the metal be extracted with difficulty; but the beſt and richeſt are in England and Scotland. The method of obtaining the metal, is by placing the ore between ſtrata of coals, and then when the fire is kindled the metal will flow; or pieces of wood may be uſed inſtead of coals or mixed therewith, according to the degree of fire that is required; for coals yield a more violent fire than wood.

The weight of Lead compared to Gold is as three to five. Lead is eaſily calcined and reduced to an aſh coloured calx, which in a more violent fire turns yellow, and at length red, when it is called minium, or red lead, which may be eaſily reduced to Lead again, when mixed with combuſtible matter and melted. Lead mixed with nitre in a crucible will flaſh a little, and if the filings of Lead be thrown into the flame of a candle, it will tinge it with a bluiſh colour. From whence it appears, that there is a ſulphureous principle in Lead, though in a ſmall quantity. When Lead is expoſed to the focus of a large burning-glaſs, it will immediately ſmoke, and by little and little change into an aſh coloured calx, then yellow and red, afterwards turning to a ſaffron coloured fluid, like oil, which in time will fly away in ſmoke; but if this fluid, before it is quite diſſipated, be taken away from the focus, after it is cold, it will turn into a red, or reddiſh yellow maſs, conſiſting of thin plates like orpiment, which are tranſparent and look like Talc. But if this be applied to the focus of a large burning-glaſs upon coals, it will immediately melt, and turn to Lead again. From hence it appears, that Lead conſiſts of a glaſſy earth, not much unlike Talc with a ſulphureous principle, that is inflammable, and not mixed intimately with the earth.

Lead will diſſolve all other metals, except gold and ſilver, and carry them off along with it, or turn into litharge or fly off in ſmoke; for this reaſon it is uſed for the purifying gold and ſilver. It will not ruſt in water like iron or copper, but will diſſolve in vinegar, ſpirit of vitriol, and ſpirit of nitre; and the ſalt which is obtained therefrom, when the ſpirits are evaporated, will have a ſweetiſh taſte; whence it is called ſugar of Lead. It will alſo diſſolve in oil and all fat ſubſtances. When Lead is reduced into a calx, though it emits a copious ſmoke, and loſes much of its ſubſtance, it will increaſe in weight, inſomuch, that an hundred pounds of Lead will increaſe to an hundred and ten, when it is converted into red Lead; but if this afterwards be reduced to Lead again, it will not yield near an hundred pounds. When red Lead is melted with ſand, it obtains a yellow gloſs, not much unlike amber. Several preparations of Lead have formerly been uſed as medicines; but, as it is an enemy to the nerves, it is in a great meaſure left off, and ought to be entirely abandoned.

Litharge is generally made in the furnaces of metals, when Lead is ſeparated from ſilver, or when Lead is made uſe of to cleanſe ſilver from other metals mixed therewith; and it ſometimes is of a ſilver, and ſometimes of a gold colour, whence it is called litharge of gold or ſilver, though it does not receive its colour from thoſe metals. Litharge is of great uſe in making plaiſters of which it is the baſis, being mixed with oil. It is a moderate drier, cleanſes with a little aſtringency, and is proper to bring ulcers to a cicatrix.

Ceruſs, or white Lead, is a ſort of ruſt of Lead prepared in the following manner: The ſharpeſt vinegar muſt be put into wide mouthed veſſels in the ſummer-time, over which a plate of Lead is to be placed ſo cloſely, that nothing can eſcape out of the veſſel: In about ten days the plate will be diſſolved, and fall to the bottom of the veſſel, from whence it is to be taken and dried, and afterwards ground in a mill. It is alſo made from the filings of Lead put into very ſharp vinegar for ten days together; or a plate of Lead may be put therein, and taken out from time to time to ſcrape off the white part; and ſo again and again, till the whole plate is diſſolved; then all the ſcrapings may be collected, ground, and made into maſſes with vinegar.

TIN is one of the ſofter and more ignoble metals; and is white, ſhining, brittle, ſonorous, and crackles when bent. It is the lighteſt of all metals, and never exiſted naturally in a true metallick form. The richeſt Tin ore is of a black or dark colour, with many ſides of an irregular figure, and a gloſſy ſurface. It is heavier than the ores of all other metals, which is ſomewhat ſtrange, becauſe Tin is lighter than all the reſt. It is indifferently hard, and bears a quick fire without melting or growing clammy. But the moſt common Tin ore is of a dark, yellowiſh, ruſty colour, and is very like the ore of iron; it is like the former in ſhape, and ſeems only to differ from

from it in its degree of purity. The garnet is a ſort of precious ſtone, and now and then contains Tin; ſo that, upon this account, it is reckoned among the ores of this metal.

Tin, in Cornwal, is extracted from its ore, after it is ſeparated from the ſtone to which it is connected, by pounding it with iron peſtles, and in the mean while it is continually waſhed with water, that the earthy parts may be carried away therewith, and that the metallick particles may ſink to the bottom. This groſs powder, after it is dried, is ground with ſtone mills, and then waſhed, till it is quite freed from all foreign matter. Then it is dried and thrown into a furnace, mixed with charcoal, which being lighted and blown with bellows, the Tin will melt and fall to the bottom of the furnace; when the workmen, opening the ſmall door of the furnace, ſuffer the metal to run into ſand prepared for that purpoſe, where it forms large maſſes. The upper part of the Tin is ſo ſoft, that it is not fit for uſe without copper; and therefore they mix three pounds of that metal with an hundred of Tin. The middle part only requires two pounds of copper; but the loweſt is ſo brittle, and ſo unfit for uſe, that they mix eighteen pounds of Lead with an hundred of Tin.

There is often an arſenical ſubſtance mixed therewith, which they call mundick, that is of a ſhining dark colour, and blackens the hands; but by the help of fire, it flies away in ſmoke. There is alſo another white ſaponaceous ſubſtance, which is ſoft, and may be diſſolved in water at firſt; but ſoon after turns very hard. It is a kind of marl. The weight of Tin, with regard to gold, is as three to eight; and is eaſily melted and reduced into a whitiſh calx.

Tin will melt ſooner than other metals, and will adhere to them very readily; for which reaſon copper and iron veſſels are often tinned on the inſide, to hinder them from ruſting, and to prevent the bad effects of the copper. If it be mixed with theſe metals, it renders them more hard and brittle, and cannot be ſeparated from them without great difficulty. Tin will not diſſolve in any ſpirit, unleſs it be aqua regia; and its ſolution will tinge gold with an elegant purple colour.

The virtues of Tin are now well known as a vermifuge; for it will kill worms, taken either in powder or filings, from a ſcruple to a drachm for ſeveral days. Salt of Tin is made of that metal reduced to a calx, by expoſing it to a reverberatory fire for two or three hours, and then throwing it into very ſtrong diſtilled vinegar. This is recommended in hyſterick fits, and is given from two grains to ſix. Moſaick, or muſive gold is made in the following manner: take of fine Tin one ounce, of Mercury revived from cinnabar ten drachms, and make an amalgama, which muſt be mixed with ten drachms of common ſulphur, and an ounce of ſal-ammoniack. All theſe, being finely ground together, muſt be ſublimed in a ſtrong fire for four hours, and a ſort of cinnabarine ſubſtance will be raiſed to the upper part of the veſſel; but at the bottom a kind of ſpungy ſubſtance of a gold colour will remain, which being waſhed in ſeveral waters, is called muſive gold. It is of great uſe to painters, and in medicine has a diaphoretic quality. It is accounted good in hyſteric and hypochondriack diſorders, as well as for killing of worms. The doſe is from ten grains to thirty. Some have ſuppoſed this to be a mercurial preparation, but falſely; for all the mercury is raiſed from it in ſublimation.

IRON is an ignoble metal, remarkable for its hardneſs, and is of a whitiſh livid colour when poliſhed; but before that it is blackiſh. When it is cleanſed it is called ſteel. The ore of common Iron is of no certain form; but is moſt commonly of a ruſty colour. There is alſo an ore which is very heavy, and of a red bluiſh colour when broken. It is very rich in the beſt kind of Iron; and uſually yields at the firſt melting, from ſixty to eighty pounds out of an hundred weight. There is alſo a ſingular kind of Iron ore, of a pale yellowiſh colour, though ſometimes grey; and ſometimes of a kind of ſemi-tranſparent white. It will yield, when melted, about thirty pounds of Iron out of an hundred weight.

The HÆMATITES, or Blood-ſtone, is alſo a ſort of Iron ore, and is very ſmooth on the outſide, when the ruſt is taken off; but the inſide is compoſed of convergent ſtreaks. It is of a dark red colour, very heavy and hard, and is one of the pureſt of the Iron ores, with a ſmall mixture of arſenick. Smiris, called in Engliſh emery, is the hardeſt of all the Iron ores hitherto known, and is almoſt as heavy as the blood-ſtone. It is of a brown colour, and certainly contains Iron, though it is not worth while to employ it for that purpoſe; and therefore it is uſed by workmen, when pounded, to poliſh ſteel and other things. Magneſia, or Magnaneſe, has no certain figure, is of a greyiſh black colour, and contains Iron; but it is not worth while to make uſe of it on that account, becauſe it will not anſwer the charges. It is uſed in glaſs-houſes to take away the green or blue colour of glaſs.

When iron is melted, it is formed into large maſſes, which are long and thick, and commonly called pigs. Theſe are melted over again, and ſtirred with an Iron rod, in order to render them malleable. While they are yet red hot, they are placed under hammers, and by that means the heterogeneous particles are forced away by the repeated ſtrokes. One ſort of Iron differs greatly from another; but that which is toughеſt is beſt; and that which is moſt brittle is worſt of all. However, all ſorts of Iron are of the ſame nature; and they are only more or leſs tough in proportion to the earthy, vitriolic, and ſulphureous particles mixed therewith. Iron being often melted and cleanſed is turned into ſteel; though, in ſome, little labour is required for that purpoſe, and in others a great deal. When Iron is very good, they melt it in a furnace, and throw in gradually a mixture of equal parts of an alkalious ſalt, and filings of lead, with the raſpings of oxes horns; then they ſtir the melted metal, and at length place it on the anvil, where they beat it into rods. Some iron will not melt over again, and then they take Iron rods as thick as a man's finger, and place them in a proper earthen veſſel, alternately with ſtrata compoſed of equal parts of ſoot, powder of charcoal, and raſpings of oxes horns. When the veſſel is full, they put a cover over it, and lute the joints, placing it in a reverberatory furnace; the fire is kindled, and increaſed by degrees, till the veſſel is hot, and after ſix or ſeven hours, they let it go out of itſelf, in which time the rods will be turned into ſteel. When this operation is not perfectly performed, and only the outſide of the Iron is turned into ſteel, in ſome parts of England, it is called caſe-hardening, and this is commonly done with the leather of old ſhoes.

Iron is the hardeſt of all metals; but it will become harder ſtill, if heated red hot, and quenched immediately in cold water. The weight of Iron when compared with gold is as three to ſeven. Iron may be converted into ruſt, by moiſtening it with water, letting it dry, and often repeating the ſame operation; but it may be preſerved from ruſt by being ſmeared with fat. Iron, calcined in a reverberatory fire, will turn into a darkiſh red, or purple calx; but being heated ſo hot as to be ready to melt, it well turn into ſcales under the hammer, which is nothing elſe but Iron half turned into glaſs. That part of the Iron, which in furnaces is turned into a

ſort of gloſſy froth, is called the droſs of Iron. This metal will diſſolve in all ſorts of acids; but alkalious Salts will not touch it.

Iron is a moſt uſeful metal, not only on account of the various mechanical uſes it is put to, but on account of the many medicines it yields. Iron has two remarkable effects, namely, that of opening and binding; for it opens the obſtructions of the liver, ſpleen, and bowels, ſtops looſeneſſes and hæmorrhages, and reſtores relaxed fibres to their due tone. For medicinal purpoſes, Iron is better than ſteel; and the filings of Iron alone, when ground ſmall, is better than any other preparation of this metal whatever. The doſe is from twelve grains to half a drachm, once or twice a day, in the form of a bolus, pills, or lozenges.

COPPER is one of the more hard ignoble metals, is ſofter than iron, and, when poliſhed, is of a ſhining reddiſh colour. It will melt in the fire, and is ſo ductile that it may be beaten into exceeding thin leaves. It is more frequently found in its metallic form than iron, in various ſhapes; but its ore never diſtinguiſhes itſelf by any certain figure, for it is almoſt always irregular. But the fineſt colours of any kind, except the red and tranſparent, moſt commonly betray the preſence of Copper; for this reaſon there is hardly any Copper-ore that is not mixed with Iron in a larger quantity than the ores of other metals commonly are. However, there is not ſo much in ſome as in others, and thoſe that contain the leaſt Iron are naturally more eaſily melted than the reſt. The vitrious Copper-ore is of a darkiſh violet ſky-colour, like that of a piece of ſteel that has touched a red hot iron. It is very heavy, and of a moderate hardneſs; but it is commonly variegated here and there with ſpots and grey veins. One hundred weight of this contains from fifty to eighty pounds of Copper. The Azure Copper-ore is of a moſt beautiful blue colour, and is not ſoft, but very heavy, and when broken ſhines like blue glaſs. This is moſt free from iron, arſenick, and ſulphur; and a great quantity of excellent Copper may be extracted out of it with very great eaſe. The Green Copper-ore is like green cryſtals, and ſometimes very prettily ſtreaked; but in other things it has the properties of the former. The light duſky blue concretes, as well as the green, called by ſome Copper ochres, yield a great deal of very good Copper when they are pure, which may be known from their colour and weight; but thoſe that are more light are mixed with unmetallic earth, and thoſe that are yellow contain iron ochre; on which account they are the more difficult to be met with, and yield leſs Copper of an inferior ſort.

The white Copper-ore has been hitherto found only in one ſingle mine of Miſnia, and is diſtinguiſhed from the white pyrites by a ſomewhat yellowiſh colour.

The Sulphureous Copper pyrites is of a yellowiſh gold colour, with a light tinge of green, both within and without. When broken, the inſide has a kind of granulated ſurface, and is eaſily beaten into powder. It contains ſulphur and Copper in many different proportions; on which account its ſpecific weight varies very much. If it is very rich in Copper, and at the ſame time is mixed with any quantity of arſenic, its gold colour becomes more yellow, and when it is broken, the ſurfaces are more ſmooth, neat and even. It is very often of a fine bright green, and blue on the outſide, and between the chinks, though when broken, it appears of a different colour. When the Copper pyrites is mixed with a conſiderable quantity of arſenic, it will then look pale like the ſulphureous Copper pyrites, and ſtill whiter when there is more arſenic. However, it may be eaſily diſtinguiſhed from the iron pyrites in being more heavy, and in not ſparkling ſo eaſily when ſtruck with a ſteel. The yellow ſulphureous iron pyrites belongs to this claſs, becauſe it often contains a great deal of Copper, which may be known from its not being of a globular figure; for, when it is in that form, it is always deſtitute of Copper. There is likewiſe an unuſual yellowiſh colour throughout its whole ſubſtance.

Copper is ſeldom found alone in its ore, for there are other metals along with it, as ſilver, iron, and lead; there is alſo a large quantity, generally ſpeaking, of a combuſtible ſulphur, not eaſily ſeparated from it. That which abounds with moſt ſulphur, muſt undergo different calcinations till all the ſulphur is exhaled, and this the workmen call roaſting. After this, the roaſted ore is beaten into ſmaller pieces and calcined again, then it is beaten very ſmall, and muſt undergo a third roaſting, after which it will melt into a ſtoney red ſubſtance, which is called the ſtone of Copper. This done it muſt be roaſted again, and then melted, when it will yield a black Copper. It muſt yet be roaſted eight times, and then it will be thoroughly cleanſed from all the ſulphur.

There is a ſort of Copper ſprings, out of which vitriol is made by boiling, and Copper may be extracted by precipitation, with the aſſiſtance of iron. There is one of this kind found near the town, called Smalnick, not far from mount Krapac in Hungary, in which there is Copper that will ſtick to iron when thrown into it; thus for inſtance, if you throw a horſe-ſhoe into this ſpring, after a few days it may be taken out covered all over with Copper. There are Copper mines in various parts of the world, but the beſt and richeſt are in Sweden and Germany.

The weight of copper, with reſpect to gold, is a little more than four to nine; and if it be expoſed to a moiſt air, it will contract a green ruſt. It has a diſagreeable ſmell, and an auſtere acrid nauſeous taſte; it will, in time, diſſolve in water, as well as in oil, and ſalts of all kinds will corrode it. Copper contains a portion of combuſtible ſulphur, though not ſo much as iron, with a metallic red earth that will turn into glaſs. Copper will turn white with the fumes of arſenick or quickſilver; but it will not continue long. Being melted with lapis caliminaris, or zinc, it will turn of a yellow or gold colour, which is called Braſs. Copper, on account of its ductility, is formed into various houſhold utenſils, and is melted into mortars, great guns, and the like; but it is ſeldom uſed in phyſic, eſpecially internally, becauſe it is of a poiſonous nature; for which reaſon it is not ſafe to uſe it in pots, kettles, and the like, without tinning.

Verdigreaſe is the principal preparation, and is of great uſe to painters and dyers; but it is ſeldom or never given inwardly by phyſicians, though it is frequently uſed externally.

SILVER is a noble and perfect metal, of a white ſhining colour, ſonorous and ductile, but not ſo perfect as gold. It is ſometimes found in ſmall maſſes of many different ſhapes, but moſt commonly like filaments and ſcales in ſeveral ſorts of ſtones and earths, and in many ſorts of land.

The Vitrean ſilver ore is of an irregular and uncertain form, is very weighty, and may be eaſily flatted with a hammer; for it is not much harder than lead, and is much of the ſame colour; for which reaſon it is often miſtaken for lead. It melts preſently, and ſoon grows red-hot. It conſiſts of ſulphur, and pure Silver, and above three quarters of it is Silver. The Horny Silver ore is half tranſparent, and is of a deeper yellow or brown colour, according as it conſiſts of larger or ſmaller lumps. It looks like roſin, and is of an irregular ſhape. When carefully examined, it appears to conſiſt of very thin plates; it is not very weighty or hard, for it may be eaſily ground; and when brought ſuddenly

to

to the fire, it crackles, burſts, and exhales a ſulphureous ſmell, and ſometimes burns lightly. This hard ſort contains two thirds of Silver. The red Silver ore is ſometimes of a lighter, and ſometimes of a deeper ſcarlet colour; the firſt caſe is tranſparent like a garnet, and has been miſtaken for tranſparent cinnabar; and in the ſecond caſe it is of a deeper dye. It is heavier than the former horny ore; but burſts when brought near a candle or a mild fire, and the remaining part melts before it grows red-hot; then it emits a diſagreeable ſmell of arſenic, together, with a thick ſmoke. It contains the ſame quantity of Silver as the horny ore juſt mentioned.

The White Silver ore is of a light grey colour of an irregular figure, pretty weighty, and very brittle. It has not only copper in it, but ſometimes more of it than of Silver; for it differs from the white copper ore in nothing but in the quantity of Silver it contains. Theſe are the principal Silver ores hitherto known, though many others are looked upon, by ſome, as ſuch, becauſe they contain a conſiderable quantity of Silver; but then there is always more of other metals along with them, and therefore they cannot properly be called Silver ores.

There are mines of Silver in many countries, as in Italy, Germany, Hungary, Norway and England; but the moſt remarkable are thoſe of Peru and Mexico. In England the veins of lead always contain a ſmall quantity of ſilver, particularly that in Cardiganſhire. Silver may be eaſily extracted from lead, by melting it in channels, made with aſhes in the furnace, and then blowing up the fire with bellows, till it turns into glaſs, ſinks into the channels, and leaves the pure Silver behind.

Silver is harder than gold, but not ſo ductile, and is lighter than gold or lead, the weight, with regard to gold, being little leſs than five to nine. It will not ruſt, but will grow black by ſulphureous vapours, and will diſſolve in aqua fortis, but not in aqua regia. When it is mixed with common ſalt, and melted, it turns into a half tranſparent maſs like horn, which is hard to be brought back to Silver again, becauſe it is volatile, and in a violent fire will all fly away. When Silver is diſſolved in aqua fortis it may be cryſtalized; and the cryſtals are very corroſive, and of an exceeding bitter taſte; when applied to the ſkin, they leave an impreſſion like that of a burning coal, and make an eſcar of a black colour. The ſolution of Silver will turn any thing black, and therefore, when properly diluted, is often uſed to colour the hair. Theſe cryſtals will melt in a very moderate heat before they grow red, and form a blackiſh maſs; it is then proper for the uſe of ſurgeons, and is called the Silver cauſtic.

GOLD, the heavieſt and moſt noble of all metals, is extremely ductile, and of a ſhining yellow. It is often found native, as it is called, but of no diſtinct figure, conſiſting only of ſmall irregular maſſes. But there is a ſtone, in which Gold is commonly contained in very large ſolid maſſes. It is likewiſe concealed, but not ſo often, nor in ſo large a quantity, in a yellow and blue ſort of ſtone, which ſome call the horny ſtone. Lapis Lazuli is a blue ſtone, and is often very elegantly variegated with very ſmall ſpecks of Gold; however, the quantity is not ſo large as in the former. Many ſorts of gravels and earths often contain Gold; but they are ſeldom rich enough to pay the charges of extracting it. However, that kind of gravel, which is found in the channels of rivers and brooks, eſpecially when they wind and turn very much, is richer in Gold than the reſt. It has been found in the rivers of Scotland, of which medals have been made, eſpecially at the time of the coronation of king Charles I.

Native Gold is not always found pure, for it is often mixed with ſilver; and there has been no ore hitherto found, in which Gold conſtituted the greateſt metallic part; ſo that no ore whatever can be properly called gold ore. However, there are Gold mines in Norway, Hungary and Guinea; but the richeſt of all are in Mexico and Peru. It is extracted from the ſubſtances in which it is contained, by roaſting, pounding, waſhing, and mixing them with quick-ſilver.

Gold is not only the heavieſt of all metals, but of all other ſubſtances yet known. It will not change with common fire, nor will it fly away in the focus of a large burning-glaſs, till it has continued there a long while. It will not ruſt, nor will it diſſolve in any other menſtruum, except aqua regia. It will mix readily with quick-ſilver, and turn into a ſoft amalgama. It may be calcined with common ſulphur when it is made glowing hot, and held thereto. When gold is diſſolved in aqua regia, and oil of tartar poured thereon, it will precipitate into a brown powder, which if heated at the fire, or lightly ground, will fly up with a great exploſion and noiſe, from whence it is called fulminating Gold. All attempts to analyze this metal have hitherto been in vain. As for the uſe of gold in phyſic, notwithſtanding the boaſting of former chemiſts, it is little or none at all; for all its preparations have been hitherto found rather noxious than otherwiſe.

CHAP. XXI.

Of GEMS of all Kinds.

OF all the Tranſparent Gems, the DIAMOND is the hardeſt, the moſt beautiful and valuable. The beſt are thoſe that are void of all colour; for if they are tinged with white, yellow or black, they are in ſome degree faulty, and conſiderably lower in price. It may be readily diſtinguiſhed from all other Gems by its extreme luſtre and ſparkling, as well as the brightneſs of its reflections. If a little burnt ivory be laid upon maſtic, in ſuch a manner as to render it black, and the diamond be laid upon it, it will then reflect the moſt lively colours every way, which is a property belonging to this Gem, as all others will not bear the like trial; for, when they are laid upon the maſtic in this manner, they either reflect no colours at all, or, if they do, they ſeem to be ſeen through a miſt. There have been jewellers, who, deſigning to make other ſtones appear like diamonds, have taken a grain of wheat, and have preſſed the oil out of it with a hot iron, and then have mixed it with lamp-black, or burnt ivory; then put it under the ſtone, but ſo as to leave a little room between it and the black tincture. Then the tranſparency, which is partly owing to the ſtone, and partly to the air, cauſes it in ſome degree to reſemble a true diamond, inſomuch that ſome, though ſkilful in theſe matters, have been deceived thereby.

Thoſe Gems that are moſt proper to counterfeit diamonds are the ſapphire, the oriental amethiſt, the topaz, and the chryſolite, becauſe they are all hard, tranſparent, and may be deprived of their colour by means of fire; but this is moſt commonly done with quick lime, or the filings of ſteel; for when the Gem is buried in theſe, and put into a crucible with charcoal, it is put over the fire, and gently heated at firſt, and when the heat is increaſed the colour will vaniſh. When it has been in a ſufficient time, they let the fire out by degrees, and do not take the ſtone out till it becomes lukewarm. If it is not entirely deprived of its colour, they repeat the operation as before; for if it was to be heated ſuddenly, or, when hot, immediately expoſed to the cold air, it would certainly crack, or perhaps break entirely.

entirely. A topaz is more fit for this purpoſe than an amethiſt, for this has been managed ſo artfully, that it could ſcarcely be diſtinguiſhed from a Diamond by the beſt judges.

Diamonds ſometimes receive their names from the places where they are found, as the Hungarian, Bohemian, and the like. Among theſe there are two differences worth obſervation; for ſome are found in the form of hexagons, and others almoſt round; but they differ greatly in hardneſs: thoſe that have angles are ſofter, and are little better than cryſtal, as the Hungarian; thoſe that are round, and in ſome ſenſe reſembling flints, are by much the hardeſt, and come pretty near the luſtre and ſparkling of oriental diamonds; but as they will not ſtand the trial of the maſtick above mentioned, they cannot properly be called diamonds. The oriental diamonds are diſtinguiſhed by the name of the places where they are found, for ſome of theſe are denominated from the old mines, and others from the new. However, they are not all equally hard, nor of the ſame colour, but they will ſtand the teſt of the maſtick; and the harder they are the more they ſparkle. Diamonds are not weighed like gold, but by carats, each carat conſiſting of four grains; and it has been ſaid, that there was one found in Biſnagar that weighed an hundred and forty carats, that is, five hundred and ſixty grains; it has alſo been reported, that there was one met with that weighed two hundred and fifty carets, and was of the ſize of a pullet's egg: However, the largeſt now known in Europe, is one that belongs to the great duke of Tuſcany, which weighs an hundred thirty nine carats and a half; and that in the poſſeſſion of the French king, which is equal to an hundred and ſix carats.

Diamonds are of ſuch a nature that no fire will injure them, for when they have remained in one for ſeveral days, they rather come out with a more perfect luſtre than otherwiſe.

The value of a Diamond ariſes partly from its ſparkling and reflections, for it will imitate all the colours of the rainbow: and partly from its hardneſs, from whence it may be ſaid to be almoſt incorruptible. Diamonds were formerly worn by kings, and other great perſons only; but now they are very common, and may be eaſily purchaſed by people in moderate circumſtances. A well poliſhed Diamond formerly, of the weight of a pepper-corn, was ſold for fifty ſhillings, but now it is not worth above two. A cut Diamond, weighing a carat, or four grains, has been valued at upwards of ten pounds; but now the price is extremely fallen.

With regard to the uſe of a Diamond, it not only ſerves for ornament, but, when reduced to powder, is extremely ſerviceable for poliſhing and cutting all other Gems whatever; and it is well known, that Diamonds themſelves cannot be properly poliſhed without it.

A Diamond ſeems to conſiſt of ſeveral plates, laid one againſt another; for which reaſon, a ſkilful lapidary, with the point of a knife, can divide one into two or more tables. If one be placed in the focus of a burning-glaſs, with its plates perpendicular to the rays of the ſun, it will receive no detriment; but if it be turned the other way, the rays will get between the plates, divide them, and afterwards turn them into a glaſſy ſubſtance, leaving not the leaſt ſign of the ſplendor of a Diamond.

The places from which Diamonds are brought, are the iſland of Borneo, and the kingdoms of Viſapour, Golconda, and Bengal, in the Eaſt Indies, as well as from Braſil, in South America.

Tavernier, who travelled to the Eaſt Indies, chiefly for the ſake of Diamonds, viſited the places where they are chiefly to be found, in order to get the beſt knowledge of them he could. The firſt mine that he ſaw, was at a place called Carnatica, in the dominions of the king of Viſapour, and at a place called Raolconda, five days journey from Golconda. This was found out above three hundred years ago; and about the place where the Diamonds are met with, the ground is ſandy, and full of rocks and low trees. In theſe rocks there are ſeveral veins, ſometimes half an inch, and ſometimes an inch broad. The miners have ſmall pieces of iron, crooked at the end, which they thruſt into the veins to draw out the ſand or the earth, which they put into veſſels; and it is among this earth they find the Diamonds. But as theſe veins are not always ſtraight, but ſometimes aſcend, and ſometimes deſcend, they are obliged to break the rock to follow the courſe of the veins. After they have opened, and gathered as much ſand as they can out of the veins, they waſh it two or three times, in order to diſcover whether there are any Diamonds among it or not. This mine yields Diamonds of a very fine water; but they are often flawed by the bad management of their hammers in breaking the rocks to pieces. If the Diamond is good, they only poliſh the ſurface a little, becauſe they are afraid of bringing it to a proper form that would leſſen its weight. But if there be the leaſt flaw or foulneſs, they give it variety of faces, or ſides, in order to hide the defect. However, it is obſervable, that they would rather ſee a black ſpeck in a ſtone than a red; and therefore, when there is one that is red, they put it into the fire, and then it becomes black. There are ſeveral men here, whoſe employment is to poliſh the Diamonds, and they have each but one wheel, which is made of ſteel, and about the diameter of a pewter plate. They apply but one ſtone at a time to the wheel, and ſprinkle it conſtantly with water, till they have found out the way in which it will beſt work. This being found, they take oil and the powder of Diamond, which they never ſpare, becauſe it is cheap here, that they may poliſh the Diamond the ſooner. There is always a little boy, who continually ſupplies the wheel with oil and powder of Diamonds. However, they cannot poliſh the ſtones ſo well as the lapidaries in Europe, becauſe as it is neceſſary to keep the ſteel rough by applying emery, or by filing it, and they are too lazy to do it ſo often as they ought, conſequently the wheel will not perform the work ſo well, nor ſo ſoon, as thoſe in this part of the world, where they take more pains.

The CARBUNCLE is a ſtone of a very deep red, with a mixture of ſcarlet, and has been formerly thought to ſhine in the dark like a lighted coal; but this is now known to be otherwiſe. It is ſaid to be as hard as a ſapphire, and to be found naturally of an angular figure, or ſmaller at one end than the other. However, as it is very uncommon, there needs no more to be ſaid about it.

The RUBY is a tranſparent gem, of a reddiſh colour, with a ſmall portion of blue, and cannot be touched by a file. The redneſs is not like that of vermillion, but of blood, or rather of cochineal, or kermes; but the leſs blue it has in it, the better it is. There are commonly ſaid to be four kinds, the Ruby-cell, the Balas, and Spinel Ruby, which with the true Ruby make up the number; and the beſt are found in the iſland of Ceylon. In Pegu they are found in a river of that name, and the inhabitants try their goodneſs with their teeth and tongue; for they judge thoſe that are coldeſt and hardeſt to be the beſt. They are ſaid to mend the colour by the aſſiſtance of fire. They are uſually met with in a ſtony matrix of a roſe-colour, and if they meet with one that is tranſparent, they then call it a Balas Ruby; but if it is otherwiſe, and has no reſemblance of a gem, it is then the true matrix of Rubies, becauſe it is formed, nouriſhed, and increaſed therein. At firſt it is whitiſh, and aſſumes a red colour, as it ripens. It is generally found in the ſame mines with ſapphires,

ſapphires, and ſome of them are pretty large; for the Emperor Rodolphus had one that was as large as a ſmall pullet's egg, and this was thought to be the largeſt that ever was ſeen in Europe.

When the value of a Ruby exceeds ten carats, it is thought to be very great, and is not exceeded by a Diamond. When a Ruby is deficient in its colour, that is, when it is not ſo red as it ought to be, ſome lapidaries endeavour to mend it, by putting a red foil under it, or glaſs of a beautiful red colour. Some have attempted to counterfeit a Ruby, with ſtones of a whitiſh colour, as a white ſapphire, topaz, or cryſtal, by the aſſiſtance of a red foil, for then it will ſparkle and ſeem to differ very little from a true Ruby; however, thoſe that have judgment in ſtones will very eaſily diſtinguiſh it. There are other methods of counterfeiting this Gem, which we ſhall here omit.

The BALAS RUBY is the matrix of the true Ruby before deſcribed, and is ſuppoſed to have its name, from its being the houſe or palace thereof, for by ſome authors it is called palas on that account. This Ruby is of the colour of crimſon, for it has a very little mixture of blue, and when it is poliſhed, it is a very agreeable gem, and will ſparkle almoſt as much as a true Ruby. It is found in veins of ſapphire, and is to be met with in the ſame places as the other; though it is not ſo valuable by far. It may be adulterated like the true Ruby, and the fraud will not be ſo eaſily diſcovered.

The SPINEL RUBY is of a deeper colour than the true, but it has not the ſplendor, for which reaſon it is more eaſily adulterated. However, there are ſome ſo good as to come very near the value of the true Ruby, eſpecially thoſe that are ſaid to be of the old rock, and are about half the value of Diamonds.

The RUBYCELL is a gem that ſeems to be between the Spinel and the Hyacinth, inſomuch that it is hard to ſay to which claſs it properly belongs. Likewiſe, they are ſometimes exceedingly like Bohemian Garnets, and are not known from them till an experiment is made in the fire; for theſe will bear it without the leaſt loſs of colour, whereas the Rubycell will either loſe or change it. They are not near ſo valuable as the Balas or Spinel.

The GARNETS have by ſome been taken to be carbuncles; for, when expoſed to the ſun, they will ſhine like a lighted coal, and much better than a ruby. They are brought from the Eaſt and Weſt Indies, and from Ethiopia, where they are of three kinds; for ſome are darker than the reſt, being of a blackiſh blood colour, and yet they will ſparkle indifferently well. When a white foil is placed under them, they are of ſuch a fiery colour, that ſome have miſtaken them for true carbuncles. Many of theſe are large, ſome having been found bigger than a hen's egg. Another ſort is of the colour of a hyacinth, and, if it was not for being redder, might be taken for a true gem of that kind. When it has a yellowiſh tinge, it may be placed among the claſs of hyacinths, and will be that ſtone called in Italy Jacintha la Bella. Theſe ſometimes reſemble other gems ſo much, that even the lapidaries themſelves are not certain what they are. Another ſort of Garnets are of a violet colour mixed with red, and theſe are better than the former, inſomuch that they are called by the Italians Rock-Rubies.

The OCCIDENTAL GARNETS are often of a fainter colour, and particularly the Spaniſh, inſomuch, that they appear like a pomegranate ſeed, and are pretty large. Some are of a yellowiſh red, and will not change in the fire, particularly the Bohemian, and they are all free from flaws. Theſe are more valuable than the oriental, on account of their reſiſting fire, and reſemble real carbuncles. Theſe are found in the fields almoſt every where by the country people, without any matrix; they are generally of the ſize of peas, and are carried to Prague to be ſold. At firſt they are ſo black on the outſide, that no redneſs can be perceived, till they are held up to the light. Others are found in Silcſia, but theſe are rough, and generally full of flaws, inſomuch, that they are ſeldom tranſparent. If a Garnet be expoſed to the focus of a large burning-glaſs, upon charcoal, it will be reduced to a metallick maſs of the nature of iron, for it may be attracted by a loadſtone.

The HYACINTH is ſo called, from its being of the colour of a flower of that name, which is of a yellowiſh red. There are four kinds, as being of ſo many different colours; the firſt is as red as vermillion, and pretty nearly reſembles Bohemian Garnets, but without any mixture of blackneſs. Theſe are more valuable than the reſt, and may be placed in the claſs of carbuncles. The ſecond ſort are of a reddiſh ſaffron colour; the third are like yellow amber, and could not be diſtinguiſhed from it, unleſs by their hardneſs, and their want of electricity. Theſe are of little value, no more than the fourth ſort, which look like white amber, and are worſt of all. The Hyacinth is found in the Eaſt and Weſt Indies, as well as in Sileſia and Bohemia.

The AMETHIST is a tranſparent gem, of a violet colour, ariſing from a mixture of red and blue. However, they are of different colours, for ſome, as the oriental, have a mixture of yellow, and ſome are purpliſh like red wine; but the beſt ſort are thoſe that ſhine moſt like a carbuncle, and are ſo hard that they may be turned into a ſort of diamonds, ſo as to deceive the moſt ſkilful lapidaries. They are found in India, Arabia, Armenia, Ethiopia, Cyprus, Germany, Bohemia, and Miſnia; but they are generally as ſoft as cryſtal, and are not in very great eſteem. The oriental are hardeſt; if they are without ſpots they are of the greateſt value. They are found of various ſizes, and in various ſhapes, from the bigneſs of a ſmall pea, to an inch and a half in diameter. They are adulterated with maſtick tinged of a violet colour, placed between two cryſtals; but the Germans do not think it worth while to counterfeit them, becauſe they are pretty common.

The SAPPHIRE, which is a hard gem of a blue or ſky colour, is very tranſparent and ſparkles very much; but ſome of them are whitiſh, and others of a deeper blue; and when they are deſtitute of all colours, they are called white ſapphires, and are ſo like diamonds they they may very well ſupply their place. They are either oriental or occidental; the former are brought from Calicut, Cananor, Biſnagor, and Ceylon; but the beſt are found in the kingdon of Pegu. It is very ſubject to flaws, and yet is ſo hard that a file will not touch it. The colour may readily be taken away by fire, and then it will be converted to a ſort of a diamond, inſomuch, that when it is ſet in a ring, it can hardly be known from one by a ſkilful lapidary. The value of a Sapphire is derived from its colour, purity, and magnitude; for if it has no flaw, and is of a deep colour, continuing tranſparent at the ſame time, it is then the beſt. It has been common to counterfeit Sapphires with a bit of blue glaſs placed between two Bohemian diamonds. Some tinge glaſs of a blue colour, and ſell it to ignorant people for a Sapphire. They are found in various ſizes; but ſeldom ſo ſmall as other gems, and yet never more than three quarters of an inch in diameter; but the uſual ſize is between the ſixth and the tenth of an inch. The ſhape is very uncertain; for it is ſometimes in one form, and ſometimes in another.

The OPAL is a moſt beautiful gem, for in different lights it ſhews all ſorts of colours, which is occaſioned by the different refraction of the rays of

light. There are four kinds of this ſtone, the firſt of which is tranſparent, without any opacity, and yet reflects all the colours of the rainbow. Another ſort is black, and yet ſparkles ſo much that it appears like a carbuncle; but this is exceeding ſcarce and conſequently highly valuable. The third ſpecies reflects various colours; but the yellow is predominant, and conſequently this is not ſo valuable as the firſt ſort. Almoſt all theſe are brought from Hungary, and are in very good eſteem. The fourth ſort is a baſtard Opal, and is of the colour of the cryſtaline humour of the eyes of fiſh; for it is a little tranſparent, and is nearly of a bluiſh milk colour or yellowiſh; and when it is turned to the light, it ſeems to ſhine at the farther edge, by means of the reflection of the light. It is by ſome called an aſterites, or the ſtar ſtone, becauſe within it may be ſeen a ſort of ſtar, which changes its place as it is turned differently to the light.

The CATS-EYE, by moſt jewellers, is not placed among the opal kind; but is thought to be a peculiar gem, and therefore will require a more diſtinct conſideration. The opals of the firſt and ſecond kind are ſeldom to be met with very large; but they are of very great value; for one in the poſſeſſion of a Roman ſenator was ſaid to be worth twenty thouſand ducats. Thoſe of the third and fourth kind are ſometimes met with pretty large; for one of theſe that reflected various colours was of the ſize of a walnut, and was valued at two hundred crowns. All ſorts of opals are found in the Eaſt-Indies; but thoſe of the ordinary ſort are to be met with in Cyprus, Egypt, Arabia, Natolia and Hungary; and in this laſt place ſome of the firſt ſort have been found in opal ſtones, though very ſeldom. There have been alſo ſome lately found in Denmark, and they are all contained in a ſoft ſtone full of black, yellow, and ſallow coloured veins. With regard to the value, it has been generally thought to equal that of ſapphires. They cannot be counterfeited like other gems with a double glaſs, nor yet any other way.

The EMERALD is a green, ſhining, tranſparent gem, and has a very agreeable appearance. It is of two kinds, the oriental and occidental; the oriental are very hard, and of a meadow green colour, which never changes in any light. They are quite tranſparent, and are in very great eſteem, they being of the very beſt kind. They are brought from the Eaſt Indies, as well as Tartary, Egypt, and other countries at a great diſtance from thence; however, they are very ſcarce, and there are very few of this kind ſeen in England. But the American Emeralds are more common, and are found principally in Peru in the earth of the mountains. Theſe are of a very pleaſant green, though they are but dull in compariſon of the former; for they are neither ſo tranſparent, nor ſo ſparkling, nor yet ſo hard; and comparatively the value is but ſmall, with regard to the former. The European come principally from Sileſia, and there are coloured cryſtals found in Germany, that commonly go under the name of occidental Emeralds. The oriental are ſeldom met with above the ſize of a hazel nut. When an Emerald is put in the fire it kindles like brimſtone, and the green colour flies off in a flame, after which it looks like a bit of cryſtal. Hence it appears, that gems in general conſiſt of two parts; namely the cryſtalline, which is fixed, and the ſulphureous, that is volatile. An Emerald is not quite deſtitute of medicinal virtues; for what is done in the fire, may, in ſome meaſure, be performed by the heat of the ſtomach, and by the digeſting fluid. However, it muſt be acknowledged, that the virtue of any ſoft of gem is not ſufficiently apparent hitherto. The beſt kind of Emeralds have always been in high eſteem; but theſe are exceeding ſcarce, as has been obſerved: the occidental being more common, and by far not ſo good, are of little value with reſpect to the former. An Emerald may be counterfeited various ways, but the beſt is by melted cryſtal glaſs, with a ſmall addition of red lead. By this method, practiſed judiciouſly, counterfeit emeralds may be produced as good as thoſe of America.

The PRASIUS, or PRASSITE, is by many thought to be the matrix of an Emerald, and perhaps not improperly, becauſe it is ſometimes found within it: for the greener parts that are tranſparent, and without any mixture of yellow, may be properly called Emeralds; and thoſe that are of a golden yellow, may have the name of Chryſopraſſites. The colour of this gem is like that of leek, or a mixture of yellow and green. It is but ſemi-tranſparent, on account of the clouds that are viſible in it; and ſometimes it has a mixture of red, white, or black, according to the various ſtones to which it has been formed. ſuch as jaſper, cryſtal, and the like. There is one ſort altogether green, another more yellow like dried fern, and a third is very little green, with a great deal of whitiſh yellow. This laſt kind is ſemi-tranſparent, and ought rather to be placed among the nephritic ſtones. This gem is very common, and ſo large, that ſtatues have been made therewith, and therefore it can be of little value. The Chryſopraſius is nothing more than a Praſſite, that has the colour of gold mixed with the greenneſs of a leek, and it looks very prettily, though it is not of much value.

The SMARAGDOPRASIUS is a gem between a Praſſite and an Emerald, and is of a graſs green colour, without the leaſt yellowneſs in it; but it is not ſo green as an emerald. It is ſometimes, though very ſeldom, almoſt tranſparent, and is called by ſome a baſtard emerald. Theſe ſtones are found in Bohemia and the Weſt Indies. The Bohemian is generally opaque, and nearly reſembles Roman vitriol. Theſe are ſaid to be the ſtones that the native Americans near the river of the Amazons wear in holes of their lips, in pieces about the length of a man's finger. Some take this to be the true nephritic ſtone; but this is doubtful, as well as its virtues.

The CHRYSOLITE is the topaz of the ancients, and is a tranſparent gem, ſhining with the colour of gold. It is of a fainter green than the emerald, and has ſomewhat of a yellowiſh tinge. Some take it to be the matrix of the emerald, and by many it is confounded with a chryſopraſius. This ſtone will not ſtand the teſt of the file, and ſometimes there are ſuch large pieces of it that ſtatues may be made therewith. The topaz of the ſhops is the Chryſolite of the ancients, and is a tranſparent ſtone of a ſhining gold colour without any mixture. It is of two kinds, the oriental and the European; the firſt of which ſhines like pure gold. The European are as ſoft as cryſtal, and have a mixture of blackneſs with the gold colour; and there is ſometimes ſo much of it, and ſo little of the yellow, that if it was not for the blackneſs, it could not be diſtinguiſhed from cryſtal. Sometimes pieces of theſe have been found to weigh twelve pounds, and there was one brought from Bohemia that was two ells in length, and near half an ell broad. Theſe ſtones may be counterfeited in the ſame manner as the reſt; but the beſt way is to put a quarter of an ounce of ſaffron of iron, and a little red lead into a pound of melted cryſtal glaſs, or if one part of calcined cryſtal be added to three of lead, and then kept for a whole day in a furnace, a topaz will be formed without any other addition.

The BERILL is a gem of a bluiſh green like ſea water, for which reaſon it is called by the Italians Aqua Marina. When it has rays of a gold colour, or the ſparkles are of that colour, it is called a Chryſoberill,

Chryſoberill, and ſome place it in the ſame claſs as the chryſopraſius. All theſe ſtones are tranſparent, and have but a faintiſh colour, for when this is more deep, they are taken for other gems. It is found of various ſizes and of different ſhapes, that are ſeldom more than a third of an inch in diameter; and the value is always in proportion to the fineneſs of the colour. It may be counterfeited by reducing burnt copper to an impalpable powder, and melting it with cryſtaline glaſs, or calcined cryſtal, in the proportion of one drachm to a pound of glaſs.

The ASTERIA, called by the Italians Giraſole, is a ſort of opal; only it is harder, and conſequently may be placed by itſelf; eſpecially as it may be diſtinguiſhed from an opal very eaſily. The harder it is, the better it reflects the image of the ſun, and ſo agreeably, that it is by ſome called the gem of the ſun. This ſtone is tranſparent like cryſtal, but much harder. It has been named by ſome the cats eye, becauſe the ſparkling is ſometimes greater and ſometimes leſs. It differs from the eyes of Belus termed by the Italians Bellocchio, becauſe it exactly imitates the iris of the eye and pupil. Specimens of this have been taken from the matrix of opal, and when expoſed to the ſun, they emit ſparkles like ſo many ſmall ſtars.

We now come to the ſemi-tranſparent ſtones, among which the SARDIUS, or CORNELIAN, is reckoned the chief. By ſome it is called the Carnelian, becauſe it is of the colour of raw fleſh, for *Caro* is Latin for fleſh. However, it is more of the colour of bilious blood. It is ſemi-tranſparent like the waſhings of fleſh, and is called by Pliny Sarda. It was in common uſe among the ancients, eſpecially for ſeals, as it is at preſent. It was firſt found by the inhabitants of Sardis, a town of Lydia in Aſia Minor, and from thence was carried to Rome; but there was a very good kind found near Babylon in the heart of a ſtone. There are three kinds of it; namely, the red, the demium (which looks duller or fatter than the former) and that which ſeems to have a mixture of ſilver ſilms. Thoſe of the Eaſt Indies are moſt tranſparent; and the thicker or fatter ſort is brought from Arabia. It is alſo found in the Weſt Indies, as well as Sileſia, Bohemia, and many other places. There are three kinds of Cornelians, the firſt of which is the red, now taken notice of. The ſecond is of a faint blood-colour, and ſemi-tranſparent; and the third is of a yellowiſh red. It is uſually found in other ſtones. It was formerly in high eſteem; but ſince other and better gems are more common, it is of little value, being chiefly made uſe of for ſeals, as was above hinted.

The SARDONYX ſeems to be of a middle nature, between the cornelian and the onyx, which its name ſeems plainly to imply. It is generally tinged with white, black, and blood-colour, which are diſtinguiſhed from each other by circles or rows, ſo diſtinct that they appear to be the effect of art. There are many kinds, and great diverſity in the colour of theſe ſtones; but the greater variety there is of theſe laſt, the more they are valued. They have ſometimes purple, blue, roſe-coloured, and yellow circles, whoſe ground is black, eſpecially the Arabian; for in the Eaſt Indies it is of the colour of horn. When the circles are not diſtinct, but as it were ſeparated, and of the colour of honey, they are of no great value. The beſt ſort is brought from the Eaſt Indies, and the next to that is the Arabian. It is found alſo in Germany, Bohemia, Sileſia, and the neighbouring countries; but it is ſeldom clear, nor are the circles diſtinct like thoſe of the Eaſt-Indies. There are pieces of the Sardonyx found ſo large, that drinking veſſels may be made therewith.

The CHALCEDONY is placed by Pliny in the claſs of rubies of a darker aſpect, and yet paler than a carbuncle; but this is evidently the characteriſtic of a garnet. This gem is generally of the ſame colour throughout; though it is ſometimes a little clouded. It is ſemi-tranſparent, and ſo hard, that it is ſeldom or never made into ſeals. It was formerly placed in the claſs of onyx's, of which it is a ſpecies, and was called the White Onyx. It is either Oriental or European; and thoſe that have a mixture of a faint colour are hard and beautiful, and are taken for the oriental. Such as theſe have a purpliſh or bluiſh mixture, or a redneſs like that of lac. Thoſe that are earthy, or of a duſky whitiſh colour, are of little value, and are met with in all parts of Germany. There are always ſome found in the Netherlands. Thoſe that are tinged with a diſagreeable reddiſh or yellowiſh colour, though they are not of the oriental kind, are in higher eſteem than the laſt. Some of theſe have been ſeen in Lorrain of a ſurpriſing magnitude, and when they have been ſtruck with a hammer have yielded a ringing ſound. Thoſe are accounted beſt of all, in which there is blue, white, yellow, and red confuſedly mixed together, and which expoſed to the ſun ſhew all the colours of the rain-bow. This alſo ſerved to make the Myrrhine veſſels of the Romans, which were ſo highly valued, and at this day they are wrought into cups, heads of great men, and the like; but its chief uſe is for ſeals, becauſe the wax will not ſtick thereto. Some of theſe ſtones, brought from the Eaſt Indies, are almoſt tranſparent, and of a whitiſh pale colour, and ſome are tinged with white circles or zones. They are now of little value, except when the pieces are large and fit for the making of figures.

The ONYX, which in Greek ſignifies a nail, is ſo called from its likeneſs to the colour of the nail of a man's hand. It is ſeldom tranſparent, and generally conſiſts of a mixture of black and white colours, which are quite diſtinct from each other. The horny colour is often marked with whitiſh veins or zones, ſomewhat reſembling an eye. The kinds of Onyx are diſtinguiſhed, either from the places where they are found, or from their different colours. The Arabian Onyx is black with white zones, and a variety of other colours. When the white zone in carving any figure is placed on the top, and the black ſerves for a ground, it is called Camehuia by the jewellers, as if it was a diſtinct gem. When it is white, it is called a Chalcedony, before deſcribed. Some Onyx's are quite black, others are tinged with ſallow colour, yellow, whitiſh, bluiſh, and horn colours, mixed in an agreeable manner. They have all zones or ſtreaks, which diſtinguiſh one colour from another. The Onyx has been ſometimes found ſo large, that columns have been made therewith; and there are now ſix of this kind in St. Peter's church at Rome. This likewiſe ſerved to make the Myrrhine veſſels before taken notice of, and is now made uſe of for cups, ſtatues, and the like. It is of greater value than the ſardonyx; thoſe are the beſt which are bluiſh at the top, and blackiſh at the bottom; and theſe are much ſought after by the Jews. This ſtone does not ſtick to wax, and therefore is as often now, as formerly, made into ſeals.

The AGATE is very like an onyx, with regard to colour, but it differs from it in being adorned with zones, whereas the Agate has none; but inſtead thereof there are lines or ſpots of various colours, in ſuch a manner as to repreſent the pictures of different things, as woods, rivers, fruits, flowers, herbs, and clouds, though not very diſtinctly. An Agate differs from a Jaſper in hardneſs and ſmoothneſs; for though the jaſper has all the ſame colours, it is ſofter, and conſiſts of rougher particles.

The

The White-veined AGATE, with delineations of trees and moſſes, is moſt commonly known by the name of the Mocha ſtone. It is of a very firm compact and fine texture, though it is found in the ſhape of a flinty pebble-ſtone. The ſizes are various, being ſometimes only one, and ſometimes eight inches in diameter. The veins of this ſtone are very beautifully diſpoſed in different figures; but generally there are many concentric irregular circles drawn round from one to three points in various places. They are commonly a little whiter than the ground, though ſometimes they can ſcarcely be ſeen. Thoſe of this kind are of the higheſt value, and contain the figures of trees, moſſes, ſea-plants, and the like, which were juſt taken notice of. Some have ſuppoſed that theſe are only petrifications, and that real moſſes and ſea plants were included therein; but this is a miſtake, which is evident from hence, namely, that the real things which they repreſent were never met with ſo diminutive as their images in theſe ſtones: for none can be ſo fooliſh as to imagine, that there ever was a perfect tree no more than half an inch high. Theſe figures are generally black, or of a duſky colour, and appear with great advantage from the whiteneſs of the ſtone. This kind of Agate, when it is perfect, is only found in the Eaſt Indies; but there are ſome of an inferior ſort to be met with in Germany. They are called Mocha ſtones, becauſe they have been brought from the Eaſt Indies to Mocha in Arabia, and from thence tranſported into Europe. However, there are ſome that will not allow them to be found in the Eaſt Indies; which if true, they may as well have the name from the place near which they are found; or at leaſt they may be brought to Mocha from other parts of Arabia, or even Aſia.

The Dull Milky AGATE is not ſo valuable as the former, though it is of a very firm texture. It is found in the ſhape of common flint ſtones, and is from one inch to ten in diameter. It is of the colour of milk, or rather like that of cream; and, when it is broken, has a ſmooth, gloſſy ſurface. It is more opaque than the former, and yet it will bear a very fine poliſh. This ſpecies is common on the ſhores of the rivers in the Eaſt Indies, and there are ſome of leſs value met with in Germany and Bohemia.

The Lead-coloured AGATE, with black and white veins, is of a very fine, firm, compact texture, though it is found, like the former, in the ſhape of common flint ſtones, and of as rugged a ſurface. The ground is of a pale bluiſh grey, or rather of a dove-colour, and is often without variation, though it has ſometimes black and ſometimes white veins, which are generally towards the centre of the ſtone. This reſembles an onyx very much, but is certainly diſtinct from it. It is very hard, and will bear a fine poliſh. It is found in the Eaſt Indies, as well as in Germany, where they make cups and ſnuff-boxes therewith.

The Fleſh-coloured AGATE is not ſo valuable as any of the former, though within it has a pretty firm compact texture, and is from one to ten inches in diameter. The fleſh-colour is very faint, and almoſt whitiſh; but yet it is never entirely wanting. Sometimes it has no veins at all, and at other times it abounds in veins, ſpots, or clouds. The ſpots are generally very ſmall, about the ſize of a pin's head, notched at the edges; though ſometimes they are much leſs. When broken in pieces it is very ſmooth and gloſſy, though it is not always of the ſame tranſparency. It is found in Germany, Bohemia, and Italy, and is worked into various ſorts of veſſels: it is alſo often made uſe of inſtead of gun-flints.

The Blood-coloured AGATE is more beautiful than moſt of this claſs. It is always of a deep blood-red colour, ſometimes throughout, but more frequently variegated with a pale blue and brown. The blue always ſurrounds the red, and inclines to the colour of whey; but it is in no other part of the ſtone. The brown is of the colour of horn, and generally appears in irregular veins, ſometimes in ſuch plenty as to make the ground to the ſtone, and the red with its blue edges only the variegation. It is not very common, though it is found in the Eaſt Indies, America, and ſome parts of Germany. It is chiefly uſed for the tops of ſnuff-boxes.

The Clouded and Spotted Fleſh-coloured AGATE is of a very fine cloſe texture, though it is ſubject to flaws and cracks when the pieces are large; for which reaſon the leſſer ſtones are moſt eſteemed; but, in general, it is in very little eſteem with us.

The Red AGATE, variegated with Yellow, is of the colour of red lead, has a fine pure equal texture, with a ſmooth regular ſurface, and is commonly found in the ſhape of a pebble ſtone. It is from one inch to four or five in diameter, and its ground is of a paler red with one that is deeper, diſpoſed in concentric veins round from one to three points; but this does not appear without cloſe examination. Beſides theſe it has irregular bright yellow blotches, that are never interſected by the veins, but are either within or on the outſide thereof; and they are always extremely ſhort, being never above a ſixth part of an inch in length. It is very hard, and will bear a very fine poliſh; it is found in the Eaſt Indies, though it is not very common there.

The Yellow AGATE has been found from one to ſeven inches in diameter in various ſhapes and ſizes; but they are all of a very firm compact texture. It is ſometimes of the ſame colour throughout; ſometimes conſiſts of irregular veins, and at others has a pale and almoſt white ground, veined and ſpotted with a ſtrong yellow, exactly reſembling that of a fine yellow bees-wax. It is very hard and capable of a fine poliſh; but the degree of tranſparency differs greatly, for ſometimes it is as much ſo as any of the reſt, and at others it is almoſt entirely opaque. It is found in the Eaſt Indies and America, as alſo in Germany, though not very good. In ſome places it ſerves to make knife-handles and the like.

The Pale Yellow AGATE, variegated with white, black, and green, is called the Leonina, from its likeneſs to a Lion's ſkin. It is more variegated than the reſt of the ſtones of this kind, and has a fine compact cloſe texture, though it is found in very irregular ſhapes, with a rugged outſide. It ſometimes ſeems to conſiſt of an irregular maſs, made up of the above-mentioned colours, and at other times is diſtinctly clouded therewith, and ſometimes again it has black and green veins in the form of concentric circles running round a point. The ground is always of a pale yellow, but very differently diſpoſed; ſometimes more, ſometimes leſs. Likewiſe in ſome, one or more of theſe colours are wanting, while others contain them all. The green is like that of Jaſper, and the black is inclinable to brown. It breaks with ſome difficulty into pieces, with fine ſmooth ſurfaces, and is brought from the Eaſt Indies; but it is not commonly known, becauſe it is very ſcarce.

The Blackiſh Veined Brown AGATE is found in ſtones that have a pretty ſmooth ſurface, though of an irregular ſhape, and from two to ſeven inches in diameter. The brown is pretty deep, and is finely clouded, ſpotted, and veined with a colour that is almoſt black, and the veins are generally paler and browner than the other variegations. The veins are diſpoſed in irregular concentric circles, and the innermoſt are generally broadeſt. There have ſometimes been vegetable ſubſtances found in the middle of it, ſuch as the ſlender roots of moſs, or of crow ſilk.

ſilk. It is capable of a very high and beautiful poliſh, and is commonly cut into ſeals, buttons, heads of canes, knife-handles, and the tops of ſnuff-boxes. It is frequently adorned with factitious colours, which ſink into the ſubſtance ſo much, that they appear like the natural veins of the ſtone; and then it is of great value.

The Greeniſh Brown Variegated AGATE ſeems to be of a middle nature between Agate and Jaſper. It is a beautiful ſpecies; and is found in roundiſh ſtones with a ſmooth even ſurface, from two to ſix inches in diameter. Its texture is very firm, and it is ſometimes of the ſame colour throughout, being only diſtinguiſhable from the true Jaſper by its hardneſs. But it has moſt frequently a browniſh green ground, variegated with irregular concentric circles, of a red, or of a finer green; it is alſo found irregularly clouded and ſpotted, with the ſame or other colours, as white, fleſh colour and yellow. It is never entirely tranſparent in thoſe that are cleareſt; and it is found in different parts of the world, but not equally good; for the European are the worſt, they being more coarſe, ſoft, and opaque than thoſe of the Eaſt or Weſt Indies.

The JASPER differs little from an Agate, only it is ſofter, and will not bear ſo fine a poliſh, becauſe it conſiſts of groſſer particles; beſides, it is not ſo tranſparent, and is moſt commonly green; and the nearer it comes to an Emerald, the higher is the value. However it is of other colours, and on that account is divided into different ſpecies, among which are included the Nephritic Stones.

The White NEPHRITIC STONE has a very fine, compact, firm texture, with a ſmooth gloſſy ſurface, and is of various ſizes; but the common ſort are two inches in diameter. The ſhape is very irregular like a common flint, and it is naturally of a fine white, with great brightneſs and tranſparency. It has ſometimes a bluiſh tinge, which makes it appear of a deep pearl colour, and upon that account is more valued by ſome; but when it is yellowiſh, it is not in great eſteem. It looks pretty much like marble, but breaks into fine gloſſy bits, and is conſiderably heavy, as well as very hard. It is found in many parts of America, particularly near the river of the Amazons. It is often cut into ſmall cups and other toys, which are extremely bright.

The Green JASPER is a bright ſemi-tranſparent ſtone, and of a cloſe, very hard, irregular texture. It has been found in maſſes of many feet in diameter, ſometimes no bigger than a horſe-bean. It is of a deep beautiful green, and almoſt always of the ſame colour throughout; though it has been ſometimes met with clouded with white. It is externally pretty, bright and gloſſy, and breaks into ſmooth pieces, ſeeming to be of a texture between flint and marble. It is conſiderably heavy, and its very great hardneſs renders it capable of a fine poliſh.

The Soft Duſky Green JASPER is not ſo heavy nor ſo valuable as the former, and is generally found in ſtones of a flat ſhape, from two to five inches in diameter. The ſurface is pretty full of ſuperficial cracks, and the colour is always dull, with ſometimes a bluiſh and ſometimes a browniſh caſt. It is ſo common in Guernſey, that it is frequently brought over with other things, and is often made uſe of to pave the ſtreets of London.

Hard Bluiſh Green JASPER, variegated with red, is called Oriental Jaſper. It may be eaſily diſtinguiſhed from all others by its blood-red ſpots, and it has a very firm and compact texture. It is found from two to ſix inches in diameter, and has a roughiſh irregular ſurface, but has no determinate ſhape. It is not at all tranſparent, except in very thin pieces, and is ſometimes veined and clouded as well as ſpotted with red. It is moſt commonly known by the name of Blood Stone, and will take a very fine poliſh. It is common in Egypt, Africa, and the Weſt Indies, and is by ſome termed the matrix of the Emerald. It ſerves for various purpoſes, particularly cups, ſnuff-boxes, and ſeals.

The Hard Whitiſh Green JASPER is the nephritic ſtone of the ancients, and is generally of the ſame colour throughout. It is harder than a Jaſper, and the ſurface ſeems as though it was ſmeared with oil. It is ſometimes of a whitiſh green, which laſt colour is ſometimes yellowiſh, and ſometimes bluiſh; but generally it ſeems to be compoſed of greeniſh white, yellow, bluiſh and black colours; but not all at the ſame time. The common ſort are from two to five inches in diameter, and the ſhape is very irregular like common flints. It is found on the ſurface of the earth, and in the beds of rivers in many parts of America, where they form them into the figures of birds, beaſts and fiſhes.

The very hard Yellowiſh Green JASPER is more dull and opaque than the former, though the texture is very firm and cloſe. The colour is properly a mixture of green and yellow, in which it differs chiefly from the former, and in its tranſparency.

The Bluiſh Green JASPER, variegated with blue and black, is a kind of nephritick ſtone, it being of a middle nature, between the oriental green Jaſper, the green nephritick ſtone, and the marble Ophites. The texture is firm and compact, and is found from four to ſix inches in diameter, and generally of a flattiſh oval ſhape, with a rough ſurface. The colour is uſually very agreeable, and is always made up of a mixture of green, grey and blue, which are ſometimes paler and ſometimes deeper, as well as inclining to other colours. Sometimes they are ſo blended, as to render it of one colour throughout, and ſometimes they are diſpoſed in clouds, ſpots and veins; and then the colours are as diſtinct as in the blood-ſtone. It is found on the banks of the great river of the Amazons in America.

The Hard Greyiſh Green JASPER is a very hard ſtone of a greyiſh green colour, approaching to that of an olive; but the green is of three different kinds. The fineſt ſort is brought from the Eaſt Indies, and the Turks and Poles make handles of it for their ſabres and cutlaſſes. It is capable of a very elegant poliſh, and is found from ſix to ten inches long, of an unequal ſhape with a rough ſurface. It has little or no degrees of tranſparency, but it is remarkably heavy, and is found only in the Eaſt Indies.

The Dull Deep Green JASPER is of a green colour like mallows, from whence it has its name, for *Malache* in Greek ſignifies Mallows. It is generally adorned with white veins, and the bluiſh colour that is intermixed is very ornamental; but when there is any black therein it debaſes the value. It is pretty heavy, and will take an excellent poliſh. It is brought from the Eaſt Indies and America, and is alſo found in Germany, and ſome other parts of Europe but is not ſo good as the former.

The Duſky Green JASPER, variegated with white and fleſh-colour, is a rough, coarſe and rugged ſtone, which is found from thirteen to eighteen inches in diameter, is generally of a roundiſh or oval ſhape, and always flatted more or leſs. The texture is firm and compact, and it is often mixed with a variety of colours diſpoſed in a different manner. It is always green in part, and has often thin tranſverſe veins of fleſh-colour and white, with ſpots and clouds of black. The green is not always the ſame, for it is ſometimes deep, and at other times light; but generally the variety is very agreeable. It is very hard, and for that reaſon will bear a good poliſh. It is common in the iſland of Jerſey, from whence it is brought among other ſtones to pave the ſtreets of London; but it might be put to a much better uſe.

Hard Variegated Purple JASPER has been called the roſe coloured Jaſper by Pliny. It has a ſmooth, fine, hard texture, though the ſurface is rough and unequal like a flint ſtone; it is ſometimes fifteen inches in diameter, and is variouſly tinged with colours, in which the red and blue are always predominant, which when uniformly mixed render it purple; but where it is blue, it is always moſt bright and tranſparent. It is brought from various parts of the world, as the Eaſt and Weſt Indies, Egypt, Germany, Bohemia and Spain; in which laſt place it is cut into veſſels and images, becauſe it will bear a very fine poliſh.

Bright Red JASPER, variegated with white, is not ſo hard as the former, nor of ſo fine a texture, and is found from the ſize of a hazle-nut to that of a man's head. The colour is that of red lead, and the moſt certain colour of the variegation is white, which is almoſt always diſpoſed in regular narrow veins, though ſometimes in ſpots. That which comes from America is generally accounted beſt.

Dull Purple and White JASPER is of a coarſe and irregular, though of a very firm texture. The purple colour ſometimes inſenſibly changes into a pale red, and the white to a yellowiſh or bluiſh colour; it is hard to ſay which of the two is predominant. It is conſiderably heavy, and ſo very hard as to be capable of a good poliſh. It is brought from Italy and Germany, as well as found in England, and ſerves to make the handles of knives and tops of ſnuff-boxes.

Pale Brown Hard JASPER, with purple veins, has much the ſame texture as the former, but is more beautiful. It is uſually found from two to four inches in diameter, and is commonly of an oblong flattiſh ſhape. Its ground is an agreeable pale whitiſh brown, and its variegations conſiſt of regular horizontal and fine deep purple veins, or of a pretty pure white. It is common in Yorkſhire and Suſſex, and is ſometimes met with in gravel pits near London.

Yellowiſh Hard Variegated JASPER has a very cloſe, hard, and compact texture, though the ſurface is very rough and irregular. It is generally met with from three to ſeven inches in diameter, and the predominant colour is a pale duſky yellow, not unlike honey. It is variegated with white, brown, lead colour, and a very pale red, with which is mixed a cloudy cryſtalline ſubſtance. Theſe colours are blended in the form of clouds; but ſometimes one and ſometimes another is wanting. It is extremely hard, will take a very fine poliſh, is common in the Eaſt Indies, and is alſo met with in ſeveral parts of Europe. The only uſe of it at preſent is to make handles for knives.

The Pale Bluiſh JASPER, with black veins and clouds, has a very cloſe firm texture, and its ſize is from four to ſix inches in diameter. It is always of a duſky blue or lead colour, and the black clouds appear like curling ſmoke. It is but of little value, and conſequently not much in uſe.

The Bluiſh Marbled JASPER, variegated with white, is of very little value. The colour is of a pale diſagreeable grey, and a pretty clear white; but the former colour is the ground, and the other appears in veins or irregular clouds. It is pretty heavy, hard, and will bear a good poliſh. It is common in the gravel pits about London, and is generally taken for a bit of blue and white marble that ſeems to be worn by the colliſion of other ſtones, for it is rounded at the edges. There is alſo a black marbled Jaſper, variegated with white, and another marbled with yellow.

The Hard Dull Fleſh-coloured JASPER is extremely hard, of a very cloſe texture, and is found from eight to eighteen inches in diameter. It is of an extremely pale whitiſh red or fleſh-colour, which is generally the ſame throughout, though there are ſometimes horizontal veins of a darker red. It is found on the ſea ſhore, and is commonly made uſe of in pavements. It muſt be obſerved, that all theſe Jaſpers ſtrike fire with ſteel, and will not effervеſce with aqua fortis.

The TURKY STONE, called by ſome the Turquoiſe, is of two kinds, the oriental and the occidental; the firſt is rather blue than green, and the other is more inclinable to the latter colour, though it ſometimes inclines to a whiteneſs. They are found in the Eaſt Indies, Perſia, Spain, Germany and Bohemia. In Perſia it adheres to blackiſh ſtones, and is very common; but it ſeldom exceeds the ſize of a hazle-nut. Thoſe of the Eaſt Indies differ in their colour, for ſuch as are ſaid to be of the old rock, always preſerve the ſame colour, but thoſe of the new, are greener. This ſtone is in ſo high eſteem among the Turks, that thoſe of the better ſort are ſeldom without one; but it is never worn by the women. It is generally valued in proportion to the brightneſs of the colour. Thoſe that are of the ſize of a hazle-nut, are of a fine ſky blue without any blackiſh veins; but the leſſer ſort are not ſo good. Thoſe that have blackiſh veins, or are inclinable to greeniſh, or to the colour of milk, are of no value. There is another Turky ſtone, which is nothing but ivory, a tooth, or a bone, which have lain in the neighbourhood of copper ore till they have been tinged with deep blue ſpots and veins; but when they are put into a gentle fire the colour diffuſes itſelf throughout the whole ſubſtance, and becomes of a very fine pale blue. There are ſeveral mines of theſe ſtones in France; but they may be perfectly counterfeited by art with a tincture of copper in an alkaly.

The LAPIS LAZULI is an opaque ſtone of a ſapphire colour, with golden ſpots or ſtreaks. It differs from an Armenian ſtone in being harder, for this may be eaſily reduced into powder; and, beſides, it is without veins of gold. This is the ſtone with which they make the colour called Ultramarine. It is of two kinds, one of which will remain unchanged in the fire, and the other not. It is found in various countries, and the Armenian ſtone is ſaid to be its matrix, which is met with in gold mines. It is found in very large pieces; but the common ſort are only big enough to make knife-handles and the tops of ſnuff-boxes. The beſt ſort, which will not in the leaſt change its colour in the fire, is brought from the Eaſt Indies; and this is the teſt whether it is right or not; for that in Germany, which is of a middle nature between an Armenian ſtone and the true Lapis Lazuli, alters in the fire, and is much more brittle than the true. However, they both will ſerve very well for the uſe of painters. Lapis Lazuli has the property of purging upwards and downwards, and therefore has been accounted good for melancholy diſorders, quartan agues, apoplexies, and the falling ſickneſs. There is no room to doubt that the blue colour ariſes from particles of copper, for which reaſon it is taken by ſome to be a copper ore.

The ARMENIAN STONE has a ſmooth ſurface, and is of a ſky blue colour; but it is brittle, by which it may be diſtinguiſhed from Lapis Lazuli; beſides which it has no gold ſpangles, nor will it keep its colour in the fire. The blue colour has a greeniſh caſt, and when it is made uſe of in painting, by length of time it changes to green. It is found in various places in Germany, as in the county of Tyrol, and in other ſilver mines. It is alſo met with in Hungary and Tranſilvania. Whenever it is uſed as a paint, it muſt be mixed with petroleum, or rock oil, and then it will keep its colour.

The ASTROITES, or STAR STONE, ſeems to be a kind of opal, and by ſome is called a Cat's Eye, or Gem of the Sun; but that which is properly ſo

called has been treated of before. It is a very beautiful ſtone, and is uſually ſet in rings; it contains the figure of ſtars ſo exactly, that no painter can imitate them better. It is an opaque gem, ſometimes of a white, aſh, duſky, or grey colour. In this ſort of ſtones are ſometimes ſeen roſes, ſometimes waves, and at other times they contain all three together; which may ſerve as ſo many different diſtinctions of this ſtone. It is found in various places, particularly in Tyrol, as large as a man's head.

The TOAD STONE ſeems to be a kind of an aſtroites; for it is of the colour of that ſtone, and marked with dark ſpots, only the aſh or grey colour has a reddiſh caſt. It is convex like an eye on one ſide, and flat on the other. There are two kinds of theſe ſtones, the firſt of which is called by ſome Brontia and Ombria, and is of a duſky, reddiſh, yellowiſh, or greeniſh colour; ſometimes of the ſize of an egg, and like one, only it is flat on one ſide. Some take theſe to be ſerpent ſtones or thunderbolts; but the common name is that of a Toad Stone. All theſe ſtones differ among themſelves: however, that properly ſo called has the name of Batrachites, but the Brontia and Ombria are called Chelonites. It is now taken to be a petrified ſubſtance, and ſome ſuppoſe it to be the tooth of a fiſh; but this does not ſeem to agree with its ſhape. Indeed there may be ſome in the form of teeth comprehended in this general name; but that reſembling an egg is the moſt common ſort. They are all hollow more or leſs, only ſome are filled up with the ſtratum in which they lay, and ſome of them reſemble the cup of an acorn. Another ſort are of an oblong figure, but round at the top, and others ſwell a little in the middle. Many of them have an outward circle of a different colour from the reſt, and this is ſometimes ſtreaked with very fine lines: ſome are alſo found very long in proportion to their breadth, and others perfectly round. They are all naturally of a very fine poliſh, and are worn in rings without alteration. They are of different ſizes, from a pin's head to two or three inches in circumference; and are of a great variety of colours, as above taken notice of.

CHAP. XXII.

Of the more ignoble STONES.

THE EAGLE STONE ſeems to conſiſt of ſeveral ſhells or cruſts laid one over another; but that which diſtinguiſhes it from all others is its being hollow on the inſide, in which cavity there is another ſtone that is ſmaller: this, when it is ſhook, may be heard to rattle. It is of various colours, as white, grey, dun, or brown. Modern authors have only three ſorts of this ſtone, the firſt of which is rough on the outſide, and is of different colours, but commonly of a black dun: this makes a very diſtinct noiſe when rattled. The ſecond is of an aſh colour, and contains a ſort of marl in the inſide, which is ſometimes white, yellow, red, or blue. The outſide is rough and ſandy, and ſeems to conſiſt of the particles of flint. A third is of ſeveral colours, but has the like contents as the former. The firſt kind is no bigger than a peach-ſtone, but the other two are often as large as a man's fiſt. Theſe ſort of ſtones are found almoſt every where.

The GEODES is a ſort of an Eagle Stone of a round ſhape, and contains ſand or earth, which makes no noiſe when ſhook; for when it rattles it may be properly placed in the former claſs. It is found in Miſnia, and near Pelſna in Bohemia. It is of a reddiſh colour, and of the ſize of a man's fiſt; but it is of no manner of uſe.

The ENORCHUS is another ſpecies of an Eagle ſtone, and is generally of the ſize of a pigeon's egg. This contains one ſtone within another, as the yolk of an egg is contained in the white. It is not ſmooth on the inſide, but is tinged with various dirty colours, and on the outſide is of an aſh colour.

Authors mention many other ſpecies of this Stone, ſuch as the rough purpliſh, the red and duſky yellow, the yellow, brown, and black cruſted, the purpliſh red, the coarſe yellow and brown, and the coarſe Eagle Stones.

There are alſo five kinds of the Geodes, which are diſtinguiſhed by the names of the Cracked GEODES with ferruginous brown and yellow cruſts. This is always hollow, heavy, and of a regular ſhape; it being oblong, and larger in the middle than at the ends. It is generally about two inches long, an inch and a quarter broad, and three quarters of an inch thick. The outer ſhell or cruſt is of a yellow colour, with a mixture of reddiſh brown, and is ſmooth to the touch, though it is all over cracked in different directions. However, it is very hard, and will not break without a ſtrong blow; and, when broken, it is found to contain a yellow earth, with a little mixture of ſand. It uſually conſiſts of three cruſts, the innermoſt of which is of a bluiſh black colour, the middle of a deep brown, and the outermoſt yellow as above. It is met with among gravel.

The Wrinkled GEODES, with ferruginous, reddiſh brown, and gold-coloured cruſts, is very heavy when pieces of it are conſidered apart; but when unbroken it is light, becauſe it conſiſts of a large hollow caſe. It is about three inches long, and two and a half in diameter, and has no diſtinct coat different from the general ſubſtance. It is of a fine gold colour, with a ſmall mixture of browniſh red, and is full of wrinkles or ſuperficial cracks. The cavity is uſually divided into ſeveral cells, and contains a ſmall quantity of fine bright yellow earth. The ſhell, when perfect, conſiſts of a great number of coats, ſome of which are of a ferruginous colour, others of a reddiſh brown, and others as yellow as gold.

The Sparkling GEODES, with ferruginous, purple, and orange-coloured cruſts, is ſubject to great varieties, excepting the internal ſtructure. However, it is generally oblong and flattiſh, and ſometimes it is full of protuberances, ſometimes branched, and ſometimes again tapering to one or both ends. It is bred among gravel, and conſequently has a very rough outſide, it being covered with pebbles of different ſizes. It is generally four inches long, two broad, and an inch and a half thick; though ſometimes it is twelve inches long. Different ſtones contain earths of different kinds; and the ſhell is compoſed of eight or ten coats, which are all bright and ſparkling. Some are of a dark iron grey colour, others of a duſky purple, and others of a ſaffron or orange colour.

The Long Rough GEODES, with a ſingle purpliſh cruſt, is always of an oblong ſhape, of a firm ſubſtance, and conſiderably heavy and hard. It is yellowiſh on the outſide, and is about four inches long, and three quarters of an inch in diameter; but the ſurface is ſtrangely rugged and uneven. It has only a ſingle coat of a mixed purpliſh iron-grey colour, and is a little ſparkling.

The Long GEODES, with a ſingle blackiſh cruſt, is always of an oblong irregular form, it appearing frequently twiſted, and of a different thickneſs in the different parts of the ſame maſs. The outſide is generally ſo inveſted with a ſtratum in which it was formed, as to appear of a browniſh yellow. It is ſometimes two inches long, three quarters of an inch broad, and above half an inch thick; but it varies in ſize. It is very brittle, and when broken is of a blackiſh colour, a little ſparkling; and the cavity

cavity is filled with very fine bright red earth, though ſometimes it is not without mixture.

The ſtone called ENHYDRUS is a-kin to the Eagle ſtone, but it contains nothing but water. The firſt of theſe is the thick-ſhelled Enhydrus with black, reddiſh brown, and yellow cruſts. It is of a cloſe, even, compact texture, pretty heavy, and very hard; and always is of an irregular roundiſh ſhape, but very flat, riſing in the middle, and thinner towards the edges. It is about four inches in diameter, and two thick where thickeſt. The ſurface is rough, and of a mixed yellow and browniſh red colour. When broken it is found to be a very thick ſhell or caſe, containing a ſmall quantity of water, which is generally muddy. The ſhell uſually conſiſts of three thick coats, of which the innermoſt is blackiſh and ſhining, but that in the middle is of a duſky browniſh red, and the outermoſt of a bright yellow. The cavity is large, and generally divided into different cells.

There are ſtill other ſtones of the Eagle kind, which may be referred to the Enorchus, of which the firſt is the very Hard Smooth ENORCHUS, with brown, yellow, and red coats. The texture is fine and compact, with a pretty ſmooth even ſurface, and is remarkably heavy. It is always of a roundiſh oblong figure, and is found from a quarter of an inch to four inches in length; but its uſual ſize is that of a pigeon's egg. It is ſometimes met with ſmooth and gloſſy, and ſometimes covered with a whitiſh cruſt. It conſiſts of only five or ſix coats, incloſing a firm, hard, and ſolid nucleus of the ſame nature and texture. This is of a deep duſky brown colour, ſometimes of a ſtrong red, and ſometimes has a mixture of both. The coats are alternately dark brown and reddiſh.

The Hard Glittering Rough ENORCHUS, with brown, purple, and deep yellow coats, is much more rugged than the former, and of a coarſe unequal texture. It is always of an oblong ſhape, and is found of ſeveral ſizes, from half an inch to eight inches long. The ſurface is made up of ſmall prominences and cavities, leſs than the heads of the ſmalleſt pins, which give it the appearance of ſhagreen. The nucleus is but ſmall, and is ſurrounded with eight or ten coats, irregular in thickneſs and of ſeveral colours, as pale brown, deep brown, duſky and reddiſh yellow; and the nucleus is ſometimes purple, but more generally of an orange colour. The ſubſtance is pretty bright and ſparkling, not only within, but on the ſurface of the ſtone.

The Soft Browniſh Yellow ENORCHUS is quite of a different nature from the former two; for this is only a compoſition of ſoft earth, though the texture is cloſe and ſmooth. It is always of a flattiſh oblong ſhape, and is commonly four inches in length, two in breadth, and one in thickneſs. It is of the ſame colour throughout, and the nucleus is of the ſame ſhape as the ſtone, but of a very agreeable browniſh yellow, as well as the coats themſelves, which are almoſt innumerable. It has no manner of brightneſs, but looks like clay. There are two other ſorts of the ſoft Enorchus, the one with a ſhining brown and duſky green coat, and the other with a ſhining whitiſh, yellowiſh, and red coat.

The HÆMATITES, or BLOOD-STONE, is ſo called from its colour, which is that of darkiſh blood; though it is ſometimes black, ſometimes yellow, and ſometimes of the colour of iron; but its ſtreaks always reſemble antimony, and when it is calcined it turns to a reddiſh colour. It was formerly divided into ſeveral kinds, but now there is only one treated of by authors. It is found in various parts of Germany, in marl-pits and iron mines. It is now known to be a rich iron ore; for, when melted, a great deal of that metal may be extracted. It is of various degrees of purity and hardneſs; for ſometimes it is of a coarſe texture, and ſeems to be compoſed of large filaments. With regard to its medicinal qualities, it is now generally uſed in ſome diſorders of the eyes, eſpecially to remove ſpots and films.

The SMIRIS, in Engliſh Emery, may be placed in the claſs of the Hæmatites. It is of an iron grey colour tending to blackneſs, and ſo hard that it is uſed by jewellers, glaſs-grinders, and ſmiths, for poliſhing their work. It will cut glaſs almoſt as well as a diamond, and is reckoned a ſort of an iron ore. It is found in large maſſes, beſpangled all over with ſhining ſpecks.

The PUMICE STONE is ſpungy and full of ſmall holes and cavities. It is of ſeveral colours, as aſh-coloured or white, which are ſo ſoft that they may be crumbled to pieces between the fingers; but ſome are more hard, though they are all ſo light that they will ſwim on the ſurface of the water. It is found in divers places, but eſpecially near burning mountains, from whence it is thrown out. It is uſed by various artiſts for different purpoſes; and in ſome places they uſe it in the baths to clean the ſkin.

The MAGNET or LOAD-STONE is well known for its property of attracting iron, and for its polarity; for, when ſuſpended, one end always points to the north, and the other to the ſouth. It is found in various places, and often in iron mines; which is no wonder, for it is a kind of iron ore. It is generally of an iron grey colour, with a bluiſh caſt, and ſometimes reddiſh without, and blackiſh within; but that which is blueſt is beſt. When a needle is touched with a Load-ſtone, the Magnet will not attract both ends equally, but will repel the one, and draw the other, which is known almoſt to every one.

CHAP. XXIII.

Of SAND-STONES, ROCK-STONES, MARBLE and ALABASTER.

THE Bright White Brittle SAND-STONE is coarſe, harſh and rough, and of a looſe porous texture. The ſurface is of a duſky, dead white; but immediately after it is broken it glitters pretty much. It is compoſed of a large angular cryſtalline grit, which is very hard and firm in the maſs; but when in ſmall pieces as ſoft as loaf-ſugar, and falls into a white ſand like powder. Water, when poured thereon, will immediately ſink through it, though it will ſtrike fire with ſteel, and will ſoon blunt the workmens tools. It makes no effervеſcence with aqua fortis; but it burns to a beautiful pale red. It is uſed in building, and will bear the weather pretty well; but it will not take a poliſh. They build houſes with it in Northamptonſhire without mortar.

The Dull Greyiſh White Brittle SAND-STONE is coarſe, rough, and of a looſe texture. It is pretty heavy, without ſplendor, and is compoſed of a large irregular grit, mixed with a ſoft looſe ſubſtance in the form of powder. When examined with a microſcope, it appears to conſiſt of an angular oblong tranſparent large grit, which adhere together in very few places; but the pores are filled up with a whitiſh powder, and while in the earth it is very moiſt and crumbly. It is much uſed in building, becauſe it cuts very eaſily. When water is poured thereon it will become wet through; but it will hardly ſtrike fire with ſteel, and yet it will make a violent effervеſcence with aqua fortis. It burns to an almoſt white fleſh colour.

The Hard White Dull SAND-STONE conſiſts of

of cryſtalline grits that are not very pure; but they are cemented together by a finer cryſtalline ſubſtance. It is very coarſe and rough, and of a cloſe, compact, denſe texture, it being very hard and pretty heavy. It is penetrated by water very ſlowly, and will not readily ſtrike fire with ſteel; but it ferments very ſtrongly with aqua fortis, and burns to a pure white. It is common in Dorſetſhire, and does not lie ſo deep in the earth as many others. It is a very good ſtone for building.

The Looſe Dull Whitiſh SAND-STONE is very coarſe and pretty heavy; it is compoſed of a very hard roundiſh grit, cemented by an earthy ſpar. It is not very hard in the maſs, and when in ſmall pieces it will crumble into powder between the fingers, and when water is poured on it, it will readily penetrate its ſurface. It will not ſtrike fire with ſteel, but will effervеſce violently with aqua fortis, and burn to a reddiſh white. This is known in London by the name of Portland Stone, where it is much uſed in building. It is ſo ſoft while in the earth, that it is uſually cut into a proper form on the ſpot, for afterwards it becomes conſiderably hard.

The Hard Greyiſh SAND-STONE is compoſed of grit of an oblong angular ſhape, many of which are purely cryſtalline, and very bright and glittering when viewed through a microſcope; but to the naked eye they appear like ſhining ſpecks ſcattered here and there. The grits themſelves do not at all cohere, but are cemented together by an earthy ſpar. It will not crumble when broken into ſmall pieces, nor is it at all duſty; likewiſe water poured on it penetrates its ſubſtance very ſlowly. It will not ſtrike fire with ſteel, though it is cut with ſome difficulty; but it will make a violent effervеſcence with aqua fortis, and burn to a white. This is what is called in London Purbeck Stone, and there are often ſhells contained therein. It is a good ſtone for building, but will take no great poliſh.

The Brittle Browniſh White SAND-STONE is very coarſe, rough and of a looſe texture, being ſomewhat porous. It conſiſts of a large angular grit, ſlightly cemented together by an earthy ſpar; when reduced to ſmall pieces it readily crumbles between the fingers, and ſticks to the hands. Water will penetrate it very freely, and therefore it is no wonder it will not ſtrike fire with ſteel; but it makes a violent effervеſcence with aqua fortis, and burns to a pale reddiſh white. It is common in many parts of the kingdom; but it is chiefly brought to London from Portland, where it is much made uſe of in building, becauſe it will ſtand the weather, though it cuts very eaſily.

The Brittle SAND-STONE, with a round grit, is known by the name of the Kettering Stone, though it is not only found about that town in Northamptonſhire, but at Ketton in Rutlandſhire. It is of a looſe texture, and ſeems to be porous when broken, which is occaſioned by the falling out of the inner part of its grit. It is pretty heavy, with but a little brightneſs, and conſiſts of a roundiſh grit laid very cloſely together, as well as cemented by an earthy ſpar. In ſmall bits it will crumble between the fingers, but not ſtick to the hand. It will not ſtrike fire with ſteel, but it ferments violently with aqua fortis, and burns to a pale whitiſh colour. It is uſed in many places for building.

The Greeniſh White Brittle SAND-STONE is coarſe and duſty, and its particles cohere ſo ſlightly, that they are continually falling off in powder. It is of a looſe texture, though moderately heavy, and is full of glittering ſpangles of talc. The grit is pretty large and angular, cemented by a very looſe coarſe earthy ſpar. Water poured thereon will readily penetrate through it, and it cuts very eaſily. It will not ſtrike fire with ſteel, but it ferments violently with aqua fortis, and burns to a reddiſh white. It is common in all parts of England, and will bear fire better than many harder ſtones.

Hard Greeniſh White SAND-STONE is very hard, coarſe and rough, though of a firm texture, and is ſpangled all over with broad glittering flakes of talc. In ſome places it is variegated with brown ſpots, and conſiſts of large grit with irregular angles, lodged in a ſort of cryſtalline cement. It is conſiderably hard in the maſs; but ſmall bits may be reduced to powder between the fingers, and it ſticks to the hands. It will not ſtrike fire with ſteel, nor make any great fermentation with aqua fortis. It burns to a pale reddiſh white, cuts eaſily, and takes a pretty good poliſh. It is ſometimes brought to London, where it is uſed in building.

The Brittle Yellowiſh Brown Glittering SAND-STONE is very coarſe, and of a looſe texture; but it is conſiderably heavy, and very full of fragments of talc. It conſiſts of large angular grit, lodged in a duſty cementitious ſubſtance, is ſoft and brittle in the maſs, and will crumble between the fingers in ſmall pieces. It will hardly ſtrike fire with ſteel, and makes but a ſlight fermentation with aqua fortis. It is uſed in building, being cheap and eaſily cut.

The Brittle Pale Brown SAND-STONE is extremely coarſe, rugged and rough. It is ſomewhat ſpungy and pretty heavy; but it has not ſo much talc as the former. It conſiſts of oblong grits with obtuſe angles, and is cemented by a ſort of cryſtalline ſubſtance mixed with earth. It is ſoft and brittle in the maſs, and is eaſily penetrated by water. It will not ſtrike fire with ſteel, nor ferment with aqua fortis. It is common in the northern counties, where they make whet-ſtones of it, which are brought up to London, and much uſed by ſhoemakers; it alſo ſerves for grinding ſtones.

The Hard Red Glittering SAND-STONE is coarſe and rough, though of a very cloſe firm texture, and will bear a pretty good poliſh. It is remarkably hard and heavy, and of a deep reddiſh brown colour, with glittering ſpangles of talc. It conſiſts of large oblong angular grits cemented with a ſparry ſubſtance. It cannot be rubbed to pieces between the fingers, nor will water ſo much as penetrate its ſurface. It is cut with difficulty, and therefore it is no wonder it ſtrikes fire with ſteel. It makes but a ſlight fermentation with aqua fortis, and undergoes little or no change in the fire. This is brought to England in large quantities from Norway.

The Hard Glittering SAND-STONE, of the colour of ruſty iron, but ſometimes more yellow and ſometimes browner, is very beautifully ſpangled with talc. It conſiſts of a ſmall roundiſh grit, cemented by a firm deep brown earth, and is remarkably hard even in the ſmalleſt pieces, but will not ſtrike fire with ſteel, though it cuts with great difficulty; nor will it ferment with aqua fortis, though it burns to a deep chocolate colour. It is very plentiful near Briſtol, where there are ſtrata twenty feet thick. It ſtands the weather very well, and is uſed in ſome places for building.

The Soft Brittle SAND-STONE, of a browniſh ruſty colour, is compoſed of large roundiſh grit, cemented with a looſe ferruginous earth. It is common in moſt counties of England, and is of little or no uſe.

The Grey Brittle Dull SAND-STONE conſiſts of large, coarſe, obtuſely angular grits, cemented by a looſe earthy ſpar. It is very ſoft and brittle in the maſs, and much more ſo when reduced to ſmall pieces. It will readily ſplit into horizontal plates, and burns to a pale whitiſh red. It will not readily ſtrike fire with ſteel, but ferments greatly with aqua fortis. It will not ſtand the weather very well; being very apt to crumble after hard froſts, though in

ſome places they cover their houſes with it inſtead of tiles.

The Browniſh White Glittering SAND-STONE has a moderately ſmooth and even texture, and is pretty firm, compact and heavy, but varies in colour on account of the earthy particles that get into the pores of this ſtone with the water. It is the moſt bright and glittering of any ſtone of this kind, and is commonly known by the name of the Flag-ſtone. It is always found in flat plates from a quarter of an inch to four or five inches thick, and the thinneſt of theſe always lie uppermoſt. It is conſiderably hard, and will not break in any direction. It will not eaſily ſtrike fire with ſteel; but ferments briſkly with aqua fortis, and burns to a greyiſh white. It is uſed in the north of England for covering houſes inſtead of tiles; that is, thoſe of the thin ſort, for the thicker are employed in paving and building. It conſiſts of grit with blunt angles, cemented with an earthy ſpar, and interſperſed with flakes of bright talc lying in a horizontal direction.

The Greeniſh Grey Shining SAND-STONE is of a hard, coarſe, rough and ſomewhat ſpungy texture; but is conſiderably heavy, and full of bright glittering ſpangles. It conſiſts of large angular grit that lie very cloſe together, among which are diſperſed great numbers of fine ſmall very bright flakes of talc, which, with the grit, are cemented with a ſmall quantity of a very pure tranſparent ſubſtance. It will readily ſplit in a horizontal direction, but not into very thin flakes. It does not readily ſtrike fire with ſteel, and makes but a ſlight fermentation with aqua fortis. It is uſed in ſome places for covering of houſes.

The Yellowiſh Grey Glittering SAND-STONE ſomewhat reſembles the former; but is very rough, coarſe and harſh, and conſiderably heavy. It is met with in many parts of France.

The Hard Purple and White Laminated SAND-STONE is the hardeſt and moſt elegant of this claſs, though very rough and harſh. It is of a very cloſe texture, extremely heavy, and the colour is finely variegated with greyiſh white and purple. The plates or flakes are much thicker than many of the former, and is extremely bright and glittering, on account of the large quantity of talc contained therein. It ſplits very eaſily, and is compoſed of fine glittering grit, cemented with a pure ſhining ſubſtance. It is extremely hard, and conſequently will ſtrike fire with ſteel; but it will not ferment with aqua fortis. It is common in Italy, where it is uſed for pavements.

The Bluiſh Glittering SLATE STONE is pretty fine and ſmooth, and of a cloſe compact texture. It is extremely heavy, and full of talky particles, and more eaſily cleaves into plates than any of the former, which are generally about one tenth of an inch thick. It conſiſts of ſmall irregular ſharp grit, that is often entirely blended with the cement, which is of the ſame cryſtalline ſubſtance with itſelf, though debaſed by a mixture of earthy particles. It is extremely hard, ſtrikes fire with ſteel, and ferments ſlightly with aqua fortis. This ſtone is common in Italy.

The Denſe Dull Whitiſh ROCK-STONE is moderately fine, but of a very irregular texture. It is compoſed of a ſoft whitiſh earthy ſpar, interſected with flat plates of the cryſtalline ſort. The earthy part of this ſtone is pretty denſe, but not ſo hard as the cryſtalline, and there is no grit of any kind. It ferments greatly with aqua fortis, and burns to a bluiſh white, mixed with a little red. This is very common in many counties, and is brought to London from different places, where it is uſed in building.

The Hard Greyiſh White Dull ROCK-STONE is of a compact texture, with a ſmooth ſurface, and is conſiderably heavy. It is compoſed of no viſible grit, and is eaſily cut; it will not readily ſtrike fire with ſteel, but ferments violently with aqua fortis. It is common in ſeveral counties of England, is uſed in buildings, and ſtands the weather pretty well: ſome burn it into a poor coarſe ſort of lime.

The Hard Porous ROCK-STONE is of a coarſe ſpungy texture, and yet very hard and heavy. It is generally of a greyiſh white, though ſometimes browniſh, yellowiſh or black, from the different kinds of earthy particles falling into it with the rain. It has no grit, and is very hard, even ſo much as to ſpoil the workmens tools. It ſtrikes fire with ſteel, but will not ferment with aqua fortis. It is common in Yorkſhire, where the ſtrata lie very deep. It is uſed for building in that county.

The Hard Bright Grey ROCK-STONE is more like cryſtal to the naked eye than the former, and conſiſts altogether of a ſparry ſubſtance. It is a very elegant beautiful ſtone, for it is bright, ſhining, and very heavy. It will hardly ſtrike fire with ſteel, but ferments violently with aqua fortis, and burns to a pale bluiſh red. It is not very common; but there is ſome of it in Yorkſhire, where they both uſe it for building and for burning into lime.

The Hard Bright Browniſh White ROCK-STONE is very heavy, and of a cloſe texture, conſiſting of a cryſtalline ſpar, which in thin plates is a little tranſparent. It will not ſtrike fire with ſteel; but ferments very briſkly with aqua fortis, and burns to a pale whitiſh red. It is brought from Purbeck to London, where it is uſed for building and pavements. It is alſo uſed in Northamptonſhire for building and making tomb-ſtones.

The Dull Yellowiſh White Hard ROCK-STONE has a cloſe firm texture, with an irregular ſurface, and is very heavy. It is of a pale dull white, with pale yellow veins and ſpots in ſeveral places; but it is not bright, though compoſed of cryſtalline ſpar. It will not eaſily ſtrike fire with ſteel, but ferments violently with aqua fortis, and burns to a white colour. It is common in Dorſetſhire, and ſometimes contains ſhells. It is very uſeful in building, becauſe it wears the weather very well.

The Dull Hard Browniſh White ROCK-STONE generally conſiſts of above half ſhells, and is a very coarſe harſh ſtone without any brightneſs. It will not readily ſtrike fire with ſteel, but ferments violently with aqua fortis, and burns to a greyiſh white. It is brought in great quantities from Purbeck to London, where it is uſed for flat pavements.

The Whitiſh Grey Marble ROCK-STONE is conſiderably fine, remarkably heavy, and of a fine firm texture. It has a ſomewhat ſparkling appearance, and is entirely without ſhells. It is conſiderably hard, and will bear a pretty good poliſh; it ſtrikes fire with ſteel, but will not ferment with aqua fortis. It is found in the Eaſtern countries, as well as Italy, and ſome parts of Germany.

The Yellowiſh White Flinty ROCK-STONE is very fine, ſmooth and gloſſy, and its texture is pretty much like that of common flint. It will hardly ſtrike fire with ſteel, but makes a very great and laſting fermentation with aqua fortis, and burns to a greyiſh or bluiſh white. It is common in ſome parts of England, and is known by the name of the Rag-ſtone and Lime-ſtone. It is generally free from cleſts; but when there are any, the ſides are always covered with a cryſtalline ſpar. It is uſed in the pavements of ſtreets.

The Browniſh White Flinty ROCK-STONE is in ſome parts of England called Chert or Wern, has a very compact firm texture, and is conſiderably heavy. It has ſometimes veins and ſpots of red, white or black. It breaks with an even gloſſy ſurface, like that of flinty pebbles: and ſtrikes fire

with

with ſteel, but makes no fermentation with aqua fortis. It is often found among other ſtrata of ſtone, and Dr. Woodward mentions one of three feet thick in Yorkſhire.

The Bluiſh Flinty ROCK-STONE is very ſoft and ſmooth, with a cloſe even texture, and is conſiderably heavy and hard. It has ſometimes bluiſh white veins, and is found in moſt counties of England. It ſtrikes fire with ſteel with ſome difficulty, and makes a ſtrong and laſting fermentation with aqua fortis. In ſome places it is burnt into lime, which is very good.

The Hard Bluiſh ROCK-STONE is very rough, and is generally full of ſhells or ſpar. Its texture is firm, and is extremely heavy; it will not readily ſtrike fire with ſteel, but ferments violently with aqua fortis, and burns to a pale whitiſh grey. It is brought from Purbeck to London, where it is uſed in pavements. It is hard to cut, and therefore not much uſed in building.

The Browniſh Blue Dull Hard ROCK-STONE is coarſe and rough, and pretty heavy. It is generally variegated with lines and ſpots of a pale red and of an opaque white. It will not ſtrike fire with ſteel, but makes a ſtrong and laſting fermentation with aqua fortis, and burns to a pale bluiſh white. It is called in Leiceſterſhire the Blue Lime-ſtone, for it makes good lime.

The Dull Pale Red ROCK-STONE is pretty fine and ſmooth, of a firm texture, and conſiderably heavy. It is variegated in moſt places with lines and ſpots of a pale red, or of an opaque white. It will not readily ſtrike fire with ſteel, but ferments violently with aqua fortis, and burns to a very pale whitiſh or greyiſh red. It is uſed for building walls in ſome places, and is alſo burnt to lime.

The Hard Shining Red ROCK-STONE is very heavy, and is ſpangled in many places with ſmall bits of a very gloſſy ſpar. It is extremely hard, and will take a good poliſh; it will not readily ſtrike fire with ſteel, but ferments violently with aqua fortis, and burns to a pale red. It is imported from Sweden, Norway and Denmark, and is uſed in pavements; it is alſo to be met with in Yorkſhire. That of Norway contains fine ſtraight ſhells, but that in England is without them.

The Green and Red Variegated ROCK-STONE has a rude irregular ſtructure, and is but coarſe for one of this claſs. However, it is not porous, is pretty heavy, and interſperſed with blotches and ſoft uneven lines of a fine paler green ſpar, as well as a few fragments of a white and ſemi-tranſparent one. It is found in the lead mines of Derbyſhire; but is of no uſe.

The Hard Black Dull ROCK-STONE has a cloſe firm texture with a ſmooth ſurface, is pretty heavy, and extremely hard; but has no gloſs, except a few ſhining ſpecks in ſome places. It is not unlike black marble, but will not readily ſtrike fire with ſteel: it ferments violently with aqua fortis, and burns to a fine bluiſh white. In Leiceſterſhire it is burnt into lime.

The Hard Black Shining ROCK-STONE is omewhat coarſe, but extremely hard, very glittering, and remarkably heavy. It does not ferment with aqua fortis, and burns to a pale browniſh red. It is found in Derbyſhire, but is hitherto of no uſe.

The Soft Dull Black ROCK-STONE has a pretty ſmooth ſurface, but no very firm texture, and though very heavy, has not the leaſt brightneſs. It has ſomewhat the appearance of ſlate, though it will not cleave; nor will it ſtrike fire with ſteel, nor yet ferment with aqua fortis. This is known every where by the name of Rag-Stone, and is more properly ſo called than the yellowiſh white one before mentioned, becauſe when broken it has a ragged appearance. This is uſed as a whetſtone all over England, for common knives and carpenters tools.

CHAP. XXIV.

Of SLATES.

THE Brittle White SLATE-STONE has a pretty cloſe texture, and is conſiderably heavy, though dull. It conſiſts of various plates from one ſixth of an inch to an inch thick, and will ſplit pretty eaſily. It will not ſtrike fire with ſteel, and ferments ſtrongly with aqua fortis. It is very common in England, and particularly in Northamptonſhire, where it lies near the ſurface of the ground. It is made uſe of to cover houſes.

The Purple SLATE is a fine beautiful kind, and is pretty heavy. It is firm and compact, and the colour is a fine pale purple, glittering all over with ſmall gloſſy ſpangles which are very bright, and ſo minute that they are not to be ſeen diſtinctly without a careful examination. It conſiſts of very thin plates or flakes laid evenly upon each other. It will not ſtrike fire with ſteel, nor ferment with aqua fortis; but is greatly valued as a covering for houſes in the northern counties of England, where it is found.

The Common Blue SLATE is almoſt univerſally known, and is a very uſeful ſtone. The texture is fine and ſmooth, and conſiſts of even plates laid cloſe upon each other, which will readily ſplit. It will not ſtrike fire with ſteel, nor ferment with aqua fortis. It is uſed almoſt all over England for covering of houſes, and is much better than tiles.

The Browniſh Blue Brittle COAL-SLATE, which is always to be met with in coal-pits, it of no manner of uſe.

The Greyiſh Black Brittle SLATE, by ſome called Shiver, is of a very looſe open texture, though pretty heavy: but the ſtructure is regularly plated, and the plates ſeldom cohere to each other. It is very ſoft, and is readily penetrated by water. It will not ferment with aqua fortis, and burns to a faint red. It is common in the northern counties of England, and is made uſe of for manuring land, in the ſame manner as marl.

The Greyiſh Blue Sparkling SLATE has a very compact texture, but ſomewhat uneven, and conſiſts of irregular plates, which will ſplit into thoſe that are very thin. When large maſſes are found, they are often bent and undulated, and towards the upper part of the ſtratum are frequently obſerved to be defective. They are compoſed of regular oblong fibres, which are all very bright and glittering when the maſs is juſt broken, having ſomewhat of the appearance of talc. It will not ſtrike fire with ſteel, nor ferment with aqua fortis; but burns to a yellow ſpangled maſs. There are large ſtrata of this in ſome of the counties of England, and is ſometimes found on the ſea ſhore. It is often uſed as a whetſtone to give a good edge to tools.

The Iriſh SLATE is the moſt ſoft and brittle of all this claſs, it being coarſe, rough, and of a crumbly texture; but is pretty heavy, and of a browniſh black. It conſiſts of a multitude of thin plates laid evenly upon each other, and ſplits very eaſily. It will not ſtrike fire with ſteel, nor ferment with aqua fortis; but will burn to a ſtrong bright red. It is ſomewhat of the nature of alum, and is very common in Ireland; it is alſo found in Somerſetſhire and other parts of England, where it always lies near the ſurface of the ground in a very thick ſtratum. It is uſed in medicine againſt bruiſes, and is given by ſome from one drachm to two in curing quartan agues; but its principal uſe is for internal bleedings.

At Iſleb, in the county of Mansfield, there is found a black Slate, which has the images of various fiſhes of a black or yellow colour; and they appear to be ſo finely done, that the very ſcales may be ſeen.

CHAP. XXV.
Of MARBLES.

THE PARIAN MARBLE is ſo called becauſe it was brought from the iſland of Paros. It is of a white colour, extremely hard, and takes a very fine poliſh. It has a firm, compact, cloſe texture, and is conſiderably heavy; its extraordinary whiteneſs has ſometimes a bluiſh caſt, with blue ſtreaks of different breadths. It is not very hard to cut, and therefore is in great eſteem among the ſtatuaries. It conſiſts of pretty large particles with flat ſurfaces, but much ſmaller and more regular in their ſize and ſhape than thoſe of the alabaſter kind. It will not ſtrike fire with ſteel, but ferments violently with aqua fortis, and when burnt is almoſt as white as ſnow. Some ſay this marble receives its name from Agoracritus Parius, who firſt carved a ſtatue of Venus out of it.

The Hard White MARBLE, called Carrara by the moderns, is whiter than the Parian, but is not of ſo great value, becauſe it is more hard to cut, and will not take a fine poliſh; however, it is uſed for building, as well as to make ſtatues. It has a more firm and cloſe texture than the former, and is very heavy; beſides, it has greater tranſparency than any other white marble. It conſiſts of ſmall glittering particles, many of which appear to have flat ſurfaces, and conſequently lie cloſe together; and it is ſuppoſed to conſiſt of a perfectly white ſpar. It will not ſtrike fire with ſteel, but ferments violently with aqua fortis, and burns to a pure white. This marble is found in Italy, from which country large quantities are brought to England.

The Hard Pale Yellow Gloſſy MARBLE is of the ſame colour throughout, and is conſiderably heavy, with a cloſe firm texture. It is very fine and ſmooth, and between the colour of honey and Venice turpentine. It will readily break in any direction into a ſmooth gloſſy ſurface. It will not ſtrike fire with ſteel, nor ferment greatly with aqua fortis; but burns to a fine pale red.

The Numidian MARBLE of the ancients is hard, ſhining, of a bluiſh colour, and is very remarkable for its hardneſs. It will bear an extremely fine poliſh, on account of its compact even texture. It is not at all tranſparent, unleſs in very thin pieces. It will not ſtrike fire with ſteel, but ferments greatly with aqua fortis, and burns to a pure white. It is found in Italy, Spain, France and Germany, and is a fine ſtrong, durable marble, though not in great eſteem.

The Black Namur MARBLE is very fine and ſmooth, having a cloſe firm texture, and is very heavy. It is full of fine ſmall gloſſy particles, which look like ſo many ſpangles. It will not ſtrike fire with ſteel, but ferments violently with aqua fortis, and burns to a pure white. It is a uſeful marble, though not much eſteemed.

The Chian MARBLE is of a black colour, and very fine and hard. It is uſed in England, as well as in other places, for a touch-ſtone; and is in great eſteem with the goldſmiths for that uſe, it being the beſt of this kind. It is perfectly ſmooth when broken, but is very dull, and does not ſhine at all. It appears to be one pure, unmixed maſs; and cuts with difficulty, but very ſmoothly. It will not ſtrike fire with ſteel, but ferments very ſtrongly with aqua fortis, and calcines to a pure white. It was formerly brought from the Iſland of Chios; but we have it now from Italy. It is capable of a very high poliſh, inſomuch that it has been uſed inſtead of a mirrour.

The Lydian STONE of the antients is a hard black Marble, in the ſhape of columns, and is called Baſaltes by Boet. It is reckoned among the Marbles by Pliny; and indeed it is the hardeſt of this kind, for a file will not touch it. It is alſo called Baſanus, from a Greek word that ſignifies to examine, becauſe this was the touch-ſtone of the antients. It is now met with in various parts of Germany, and particularly in Sileſia; but the greateſt quantity of it known is the Giants Cauſeway in Ireland, which appears ſo regular that it was at firſt taken to be a work of art. This Marble is of a very fine, ſmooth, even texture, and is of ſo gloſſy a black that it reſembles high-poliſhed ſteel, without any foreign matter. It is always found in one ſmooth homogene maſs, but not in quarries like other Marbles; for it always ſtands upright in regular columns, conſiſting of a great many joints, one of which is exactly placed and fitted to the other. A vaſt number of theſe are ſo regularly put together, and joined by their ſides, that they ſeem to have been placed ſo by a very ſkilful workman. Many of theſe columns make large pillars, ſome of which are at ſmall diſtances from each other. The ſingle columns are all angular, and conſiſt of from four to ſeven angles; but the firſt are moſt uncommon. It will not ſtrike fire with ſteel, which muſt be on account of its ſmoothneſs, for it is certainly hard enough for that purpoſe; likewiſe it makes little or no fermentation with aqua fortis. This ſtone may be made uſe of on various occaſions, and is well known to make the very beſt kind of burniſhers for poliſhing ſilver.

The Lacedemonian MARBLE of the ancients is of the green kind, and is taken notice of by Pliny. It is different from the Ophites, becauſe that is variegated with ſpots like ſerpents, from whence it took its name, for that word ſignifies a ſerpent; beſides, the columns that are made with this laſt are always very ſmall. There is alſo another of this kind, of a dark green, which is finely painted with croſſes of a lighter colour, which are ſo fine that common ſpectators would take them for the effect of art. This Marble has a cloſe compact texture, and is very hard and heavy. It is of a fine bright green, and takes a very good poliſh. It will not ſtrike fire with ſteel, but ferments violently with aqua fortis, and burns to a pure white. It was firſt brought from Lacedemonia, afterwards from Egypt, and is now found in Germany, Sweden, and England. There is ſaid to be a ſtratum of it near Briſtol, and many in Wales, where it may be had in any quantity.

The Derbyſhire MARBLE is of a whitiſh brown colour, and has a fine cloſe texture. It will not ſtrike fire with ſteel, but ferments violently with aqua fortis, and burns to a pure white. It is ſo full of marine ſubſtances, that four fifths of the whole maſs ſeem to be compoſed thereof; it is particularly full of entrochi, which are a ſort of ſhell of an oblong round form, furrowed on the outſide, as if it was divided into joints, marked with a ſtar at the end, which are ſuppoſed to be part of the Star Fiſh; but this is uncertain. They are of all ſizes, from the thickneſs of a large pin, to half an inch or more. They will take a very elegant poliſh in the maſs, and are much uſed for chimney-pieces, tables, and the like. It is found in vaſt quantities in Derbyſhire, and ſome will not allow it to be Marble, but call it the Derbyſhire Stone.

The Green MARBLE, thick ſet with ſmall ſea ſhells, is of a very beautiful kind, and will bear a very fine poliſh. It is of a delightful bright green; but does not ſparkle. The roundiſh black lines, and pale browniſh white ſpecks that are found in it, are thought to be ſmall ſea ſhells, filled up with an impure white earthy opaque ſpar; but, be that as it will, it is a very elegant curious Marble. It ferments violently with aqua fortis, and calcines to a pure white. There are very large quarries of it in Germany, Bohemia, and ſome parts of France, where

where it is uſed in the ornamental parts of buildings.

The Greyiſh Green MARBLE, thinly ſet with ſhells, is ſomewhat coarſe and rough, and of an irregular and pretty firm texture, moderately heavy, and conſiderably hard. It is of a dull duſky greyiſh green colour, and will ferment violently with aqua fortis. It is found in Derbyſhire, Dorſetſhire, and Eſſex.

The Hard Greyiſh Black CORALLOIDE MARBLE, has a very fine ſmooth even texture, and is conſiderably bright and ſparkling; but does not ſeem to conſiſt of a homogene maſs when broken, but of many cloſely compacted particles. It abounds with a ſort of coral called Porus, ſet at ſmall diſtances and in all directions: they are generally about an inch and a half long, and three quarters of an inch broad, and are compoſed of longitudinal plates, which are very fine, thin, and of a ſnow white colour. In the moſt perfect ſpecimens there are proceſſes like wings, of a cloſe irregular net-like texture, expanded on each ſide near the top, and of this ſort of texture the whole body is full; the interſtices are filled up with a greyiſh white ſpar, and form a very beautiful figure. It is found in great plenty in Derbyſhire, and according to Dr. Woodward in Wales. The tomb of Sir Thomas Greſham in Great St. Helen's church is built with it.

The Black CORALLOIDE, marbled with ſhells, is of a very cloſe, firm, even texture, and is very hard and pretty heavy; it will bear a very fine poliſh. It is variegated with a Coralloide Porus not unlike the former, but ſmaller. There are alſo great numbers of large ſea ſhells of the turbinated and bivalved kinds, lodged in various directions, and of a clear bright white. The cavity of the porus and ſhells are all filled up with the black ſubſtance of the marble; but they retain their ſhape in a very perfect manner. It ferments violently with aqua fortis, and is common in Ireland, from whence it is brought to London.

The Purple and White Variegated MARBLE is generally pretty fine, with white veins, ſpotted and variegated with purple. In ſome blocks the purple makes the ground, and the veins and ſpots are white; there are alſo blotches of other colours, as pale red, pale brown, yellowiſh, greeniſh, and yellowiſh brown. The different ſubſtances, which compoſe this Marble, are generally diſtinct maſſes, particularly thoſe of the purple and white kind. The whiteſt is moſt pure, and therefore is hardeſt, brighteſt, and moſt tranſparent. The pale red is next, the purple next to that; but the browniſh, greeniſh, and yellowiſh, are very earthy, and almoſt perfectly opaque. There are ſilvery particles in this Marble, which are ſuppoſed to be a very pure ſpar. This is a common Marble in Italy, and great quantities of it are brought to England.

The Brown and White Brittle MARBLE is the ſofteſt of this claſs, and has a pretty coarſe texture; but it is conſiderably heavy, and of a pure ſnow white, finely variegated with ſlender lines, and veins of a deep brown earthy colour, and in ſome places there is a faint caſt of pale red: when broken, glittering particles appear as in the former, which are diſpoſed in ſmall flakes. The white parts or ground are extremely like the fineſt loaf-ſugar, and is ſo ſoft that it may be cut with a knife. Water will readily ſoak through it, and it makes a violent effervеſcence with aqua fortis. It is common in Italy, and ſerves to make chimney-pieces.

Hard Variegated Red and White MARBLE is very fine, remarkably heavy, and is ſomewhat of a bluiſh ground, finely variegated with red, brown, and yellow veins. It is very glittering in many parts, and will take a very fine poliſh. It will not ſtrike fire with ſteel, nor ferment greatly with aqua fortis. It is a beautiful Marble, and is found in great plenty in Devonſhire, from whence it is ſent to London.

The Blue and White Variegated MARBLE has a large rough grain, is moderately heavy, and is of a bluiſh white, or of a fine bright pearl colour, variegated with broad veins of a duſky blue, which often make up the greateſt part of the Marble. The white parts when broken appear bright and ſparkling, but their texture is looſe. The blue is of a ſmooth texture, and extremely dull. It is moderately hard, and takes a very good poliſh. It ferments violently with aqua fortis, and burns to a greyiſh white. It is common in Italy, from whence large quantities are brought to England, where it is uſed for monuments.

The Pale Brown MARBLE, with white and red veins, has great variations, both with regard to the ground and the veins. The texture is pretty fine, cloſe and ſmooth, and is conſiderably heavy. The veins are ſometimes of a bluiſh white, without any other mixture, and in ſome they are only red. The red is of all degrees, from the brighteſt colour to the purple of porphyry. It is conſiderably hard, and takes a very beautiful poliſh. It ferments violently with aqua fortis, eſpecially in the red and white veins. It is a common Engliſh Marble, and there is great plenty of it in Cornwal, Devonſhire, and Wales. It is uſed in London for tables.

The Brown MARBLE variegated with white and black is pretty fine and ſmooth, though ſubject to cracks and flaws. It is moderately heavy, and the brown colour is variegated with very beautiful whitiſh and black branded veins of various figures: ſometimes it is difficult to determine whether the white or brown is the ground. The brown is of different degrees of colour, and is diſpoſed in a very odd manner; for it ſometimes, when black, ſeems to reſemble rocks, clouds, rivers and landſcapes. It is common in many parts of Italy, where it is in good eſteem for ornamental works.

The Hard Brown MARBLE, variegated with white, and is the hardeſt of this claſs, is remarkably heavy. It generally conſiſts of only two colours, yellowiſh brown, and a duſky white; but they are in many different proportions, and the veins are compoſed of very different ſhades, which generally reſemble the windings of rivers, and ſeldom any thing elſe. It ferments but little with aqua fortis, nor will it readily calcine; it is very hard to work, therefore is not much in uſe; it is found in Italy, but not very common.

The Yellow and Purple Variegated MARBLE is a very curious kind, and the ground is of a beautiful pale yellow, with fine purple veins; there are others that are dark browniſh, blackiſh and white. The ſtructure is ſmooth and even, and it will bear a very elegant poliſh. It will ferment ſomewhat briſkly with aqua fortis; and when calcined turns to a beautiful pale red. It is found in Italy, and with us bears a very great price.

The Blue and Yellow Variegated MARBLE would be very valuable, if it would admit of a fine poliſh; but, as it does not, it is not in great eſteem. The ground, which is coarſe, is of a deep yellow, mixed with a fine blue; which in ſome places is ſo deep as to be almoſt black, and in other places ſo light that it looks like a pale grey. Its texture is looſe and open, and it is common in Spain, Italy, and Africa.

The Black MARBLE, with white veins, has a very firm texture, and is of a fine deep black, variegated with narrow white veins, running generally ſtraight and even. It is pretty hard, and will bear a good poliſh, and when broken one way it is very bright and ſparkling. It ferments but little with aqua fortis, and calcines to a duſky grey: it is com-

mon in Italy, and is uſed with us for chimneys and tables.

The Bluiſh Black Hard MARBLE, with ſnow-white veins, has a ſomewhat rough and harſh texture; but is conſiderably hard, and will bear an excellent poliſh. It is ſomewhat bright and glittering when broken in the black part, and the white veins glitter greatly. It ferments violently with aqua fortis, and when calcined is of a mixed grey. It is common in Italy, and is brought to us from Leghorn.

The Black and Yellow Variegated MARBLE has a very fine cloſe texture, and is very heavy. The black is deep, and variegated with a great number of yellow veins. It will bear a very fine poliſh, and then the yellow veins look like gold; but when there is any white, they appear like ſilver. There are great quantities of this Marble brought from Italy, becauſe it is of very great uſe with us, and highly eſteemed.

The Black MARBLE, with white and red veins, is of an irregular but cloſe texture, and is conſiderably heavy. The ground is black, and ſometimes inclines to blue, and the variegations are chiefly of a clear bright white; but there are ſome of a beautiful red. Sometimes the white part is ſo great, that it is hard to determine whether the white or black is the ground. The red veins commonly appear of a granulated ſtructure, and the whole is very hard, and will bear a very fine poliſh. It will not ſtrike fire with ſteel, but ferments pretty briſkly with aqua fortis, and burns to a mixed grey. There is a great deal of this Marble in Ireland, from whence it is ſometimes brought, though very rarely.

The Black MARBLE, with red, white and yellow veins, is pretty coarſe and rough, though of a firm texture. The ground is of a deep black, which is beautifully variegated with all degrees of red, yellow and white, diſperſed in irregular veins. It is brighteſt in the white part, and the red and black ſparkle, though very little; but in the red it is ſcarcely perceivable. It takes a pretty good poliſh, and ferments though but little with aqua fortis, except in the white veins.

The Green MARBLE, variegated with white veins, was in much eſteem with the antient Romans. It has a firm compact texture, is remarkably heavy, and green and white are of ſuch different degrees, that they make a very agreeable variegation. Beſides theſe, there are ſpots and veins of a blackiſh colour, and the whole is ſo hard that it will bear a pretty good poliſh. It ferments briſkly with aqua fortis, except where it is green and flaky; and is brought from Egypt and other places.

The Greeniſh Black and White Spotted MARBLE is the black Ophites or Serpent-Stone of the antients. It was ſo called becauſe it had ſpots in the form of ſerpents; for the name was owing to the figure of the ſpots and lines, and not of the ſtone itſelf. It is a very beautiful and pretty hard marble, of a firm texture, and remarkably heavy; the ground is a very fine green, variegated with ſmall black ſpots and irregular lines, and ſometimes with thoſe that are white. They are ſometimes pretty large, and half blended with the general ſubſtance of the maſs, and ſometimes there is the bluſh of purple throughout the whole. It ferments violently with aqua fortis, and burns to a mottled grey. This marble is now found in various parts of the world, and particularly in the iſlands of the Archipelago; there is alſo a ſort of it in Wales, which is known by the name of the Angleſea Marble.

The Greeniſh Soft MARBLE, variegated with white and black veins and ſpots, is the white Ophites of the antients. It is of a pretty fine ſmooth texture, moderately heavy, and when pure, of a very elegant pale green, with ſpots, clouds and lines of a fine deep black and whitiſh green, which is ſometimes entirely white. It is ſoft and eaſily cut, but looks very bright when wrought. It ferments violently with aqua fortis, and burns to a duſky grey. It is found in France, Italy, and Germany.

The Aſh-coloured MARBLE with ſmall black ſpots, is the Tephria and grey Ophites of the antients. It is a fine ſmooth marble, pretty firm and compact, and conſiderably heavy. The aſh colour is lively and beautiful, the black ſpots of irregular figures, and the ſixth part of an inch in length. It is pretty hard, and takes a fine poliſh. There is a great deal of this in Germany, but it is not ſo good as that of the antients, which is brought from Ethiopia and Egypt.

The Greyiſh Brown MARBLE, with bright green ſpots, has an even texture, is conſiderably firm, and very heavy. The ſpots are ſmall, generally of an oblong figure, and will take a very fine poliſh. The green parts eſpecially ferment greatly with aqua fortis, and burn to a pale mottled grey. It is common in Egypt and Arabia, and is ſaid to be met with in England.

The pale grey MARBLE, with green ſpots and veins, is extremely firm and very heavy, and in ſome places ſlightly tinged with a very faint red, and in others with a colour that is nearly white. It is variegated with a very beautiful pale green, conſiſting of ſmall oblong irregular ſpots, and ſometimes of narrow uneven veins. It is very heavy, and will bear a beautiful poliſh. It is common in Germany, and Dr. Woodward takes notice of a ſpecimen found on the ſea ſhore in Cornwal.

The Red MARBLE, with white and gold veins, is the Theban marble of the antients. It is a very beautiful marble, and of a very ſmooth regular texture. The red is variegated in ſome places only with white, and in others only with yellow or gold colour; theſe are very large and broad in ſome places, and very narrow in others, for they generally make up almoſt half the maſs. It is found in Egypt, Italy, Germany and England; but the Egyptian is the fineſt, and the Engliſh the worſt.

CHAP. XXVI.

Of ALABASTER, PORPHYRY and GRANITE.

THE Snow-white Shining ALABASTER is that called the Lygdine by the antients. It is not very compact; but is heavy, and conſiſts of a multitude of broad, flat, large particles, which are very bright and perfectly white. It cuts very freely, and is capable of a fine poliſh. There are very large ſtrata of it in Arabia, Egypt, and many parts of Italy; but it is ſeldom brought over to England.

Whitiſh Yellow ALABASTER, of a ſoft conſiſtence, is of a looſe open texture, conſiderably heavy, and nearly of the colour of honey; but the colour is more deep in ſome places than others. It conſiſts of irregular pieces that lie in tables one over another, though with regularity; however, they all together compoſe a remarkably bright maſs, which is very brittle. It is found in Cappadocia, and has been met with in Germany and France, as well as in Derbyſhire.

Yellowiſh and Reddiſh Variegated ALABASTER is the common Alabaſtar of the antients. It is ſo ſoft that it may be cut with a knife, and has the ſame name in all languages. It is remarkably bright, glittering and almoſt tranſparent, and its texture is very looſe and open, though it is moderately heavy. The ground is of a fine clear pale yellow, between that of honey and amber, and has the ſame texture as the former; but is beautifully variegated with crooked undulated veins, ſome of which are broad, and

and others narrow; ſome of a pale red, others whitiſh, and others again of a very agreeable pale brown. It will bear a very fine poliſh, and conſiſts of large angular ſparry concretions. It is not proof againſt water, ferments violently with aqua fortis, and burns to a pale grey colour. It was formerly found in Egypt, and is now met with in many parts of England.

Purple PORPHYRY, with pale red and white ſpots, is the Porphyry of the antients, by whom it was placed among the red marbles, of which it was reckoned the chief, on account of its hardneſs and ſplendor. It is named Porfido by the Italians, and there are two columns of it before the gates of St. John Baptiſt, in Florence. The texture is not ſo fine as many of the common marbles, and it always breaks with a rough irregular ſurface; but is remarkably firm, compact and heavy, and of a fine deep purple variegated more or leſs with pale red and white ſpots, as alſo a few flaky black ſpots. The purple is of all degrees, from the colour of claret to that of a violet, and the variegations are generally diſtinct ſpots of various ſizes. It approaches the neareſt to the hardneſs of a gem, and was always in very high eſteem. It is found in great plenty in Egypt, which was always famous for this ſtone; but now it is met with in other places, at leaſt with variations. They will all ſtrike fire with ſteel, but will not ferment with aqua fortis. This is frequently made uſe of as a ſtone for grinding colours.

The PORPHYRY of the colour of red lead, variegated with black, white and green, has the hardneſs and all the other characters of purple Porphyry; but it excels it in brightneſs, and in the beautiful variegations of the colours. The texture is harſh, rough and irregular, but it is remarkably heavy. The ground is of a bright red lead colour, and in various degrees. It has very regular green veins, and ſome that are perfectly white, with a great number of ſmall black ſpecks; but theſe are never mixed with the green, that make a conſiderable part of the whole. It takes an exceeding fine poliſh, ſtrikes fire with ſteel, and will not ferment with aqua fortis. It is found in the iſland of Minorca, and this might ſerve for many valuable purpoſes, if it was imported into England.

The Pale Red PORPHYRY, variegated with black, white, and green, is of a very compact firm texture, conſiderably heavy, and of a pale fleſh colour, often approaching to white. The variegations are in large blotches from half an inch to an inch broad, and now and then diſpoſed in irregular veins. The ſurface is bright but does not glitter, and its extreme hardneſs renders it capable of a very high poliſh. The red, white and green parts appear to be all tabulated, and the green has a tinge like that of gems, and is the brighteſt of all, it being nearly tranſparent. It is found in Arabia Petræa, and in Upper Egypt. There are alſo ſmall pieces of it in Germany and Ireland, and they have been ſometimes ſeen in Devonſhire on the ſea ſhore.

The Hard White GRANITE, with black ſpots, called in Cornwal Moor-Stone, is of a large and groſs texture, and appears to be a rude, but beautiful maſs of variouſly conſtructed and differently coloured particles, diſtinct from each other, though they cohere very ſtrongly. It is conſiderably hard, and mottled with black and white, among which there are perfectly tranſparent particles that are very bright; there are great numbers perfectly black, and others of the colour of brown cryſtal: ſome of theſe interſect, and are divided by other granulæ; but others lie parallel with, and others evenly upon them; and others again are quite buried in the ſubſtance of the cryſtalline particles, like flies in amber. Some again are ſingle and thin plates, and others large and broad laid ſingly on each other. The whole is extremely bright and glittering, and will take a pretty good poliſh. It ſtrikes fire with ſteel, but will not ferment with aqua fortis, and undergoes little change in the fire. There are vaſt quantities of this in ſome parts of Ireland, as well as in Cornwal and Devonſhire, where it is found in exceeding large maſſes on the ſurface of the ground. It is uſed in London for the ſteps of publick buildings.

The exceeding Hard Red GRANITE, variegated with white and black, is the Syenites of Pliny, and the Oriental Granite of the moderns. It is called by the Italians Granito Roſſo, and of this the obeliſks are generally made in Egypt. Travellers tell us of an obeliſk, in Alexandria, made of one ſolid block of this Marble, which meaſures eighty feet in height. The texture of this Granite is coarſe, harſh and rough, but extremely heavy. It is of a very beautiful pale red, variegated with white and black. All parts of it are bright and glittering, being capable of a very fine poliſh. It ſtrikes fire with ſteel, but will not ferment with aqua fortis.

The Pale Whitiſh GRANITE, variegated with black and yellow, is found in the iſland of Minorca, where there are vaſt quantities of it. It is often found on the ſhores of the iſland of Guernſey, and is uſed for pavements in the ſtreets of London.

CHAP. XXVII.

Of Common Circumſcribed STONES.

THE Brown STONE, grey on the outſide and divided by partitions, has a very firm compact even texture, with a ſmooth ſurface. It is of various ſizes, but generally between ſix and twelve inches in diameter. They are not always of the ſame ſhape, but are moſt commonly roundiſh, or inclining thereto. They have always a multitude of fine flaws like thoſe of common flints, which chiefly appear upon breaking them; and they always break in theſe flaws, which are lined on both ſides with an extremely thick cruſt of grey clay. Beſides theſe narrow cracks, there were originally others, which are now filled up with a pure ſpar of a pale yellowiſh white, and pretty tranſparent. Theſe are always thickeſt in the centre of the ſtone, and become thinner and narrower as they approach the ſurface. The ſtony matter of this kind is conſiderably heavy, moderately hard, and will bear a ſlight poliſh. It will not ſtrike fire with ſteel; but ferments violently with aqua fortis, and turns to a whiter colour in the fire; the matter, which divides the ſeveral parts, burns to a pure white. It is very common in England, and ſometimes contains ſhells, beſides a beautiful delineation of ſhrubs, plants, and moſſes.

The Hard Brown STONE, with few diviſions, has not a grey cruſt like the former, but the colour within is nearly the ſame. The texture is firm, but the ſurface rough and irregular; and the uſual ſize is from four to twelve inches in diameter. The ſhape is different, but it has always ſomewhat of an oval; and when broken there are ſmall ſhining ſparry ſpecks. The diviſions or ſepta are very few, which appear in the form of ſhining veins; and there are ſome that have none at all. It will not ſtrike fire with ſteel, but ferments greatly with aqua fortis, and calcines to a greyiſh white. It is common in the clay pits between London and Iſlington.

The Hard Blackiſh Brown STONE, with whitiſh partitions, is coarſer than the former; but the texture is firm, and it breaks with a rugged uneven ſurface. It is ſeldom above ſix or eight inches in diameter, and often no bigger than a hen's egg, but

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the ſhape is nearly round. It is always covered with a pale brown cruſt, about the third of an inch thick, where it is ſofter than within. The diviſions are very numerous, and always filled up with a whitiſh ſpar. The inſide of the ſtone is of a duſky brown, with irregular variegations of black. It is conſiderably heavy, and will take a pretty good poliſh. It will not ſtrike fire with ſteel, but ferments with aqua fortis, and burns to a pale reddiſh white. It is found in moſt parts of England, and is common near London.

The Hard Browniſh Yellow STONE, with yellowiſh white partitions, is very firm and hard, with a ſmooth compact texture. When broken it has a ſmooth flinty ſurface, is of various ſizes from four to twelve inches in diameter, and generally roundiſh with ſomewhat of flatneſs. It is covered with a deep yellow cruſt, ſofter than the ſubſtance of the Stone, which will crack when expoſed for ſome time to the air. This Stone is very hard, heavy, and will bear a tolerable poliſh.

The Hard Greyiſh Brown STONE, with brown partitions, is very cloſe and compact, and has a very ſmooth ſurface when broken. It is met with from three to four feet in diameter, and the ſhape is always irregular. It is without a cruſt, and ſometimes appears a little bright. The veins, which are few, are very broad; and, though it is remarkably hard, it will not ſtrike fire with ſteel, but ferments violently with aqua fortis, and calcines to a greyiſh white. It is common about London and elſewhere.

The Hard Ferruginous Brown STONE, with brown partitions, is very firm, ſtrong, and of a compact regular texture, with a ſmooth even ſurface when broken. It is two or three feet in diameter, is generally broad and flat, and moſt commonly without a cruſt. It breaks into thin flakes in a very regular manner, with a great many ſhining ſpecks. It is remarkably heavy, very hard, and will bear a pretty good poliſh. It will not ſtrike fire with ſteel, but ferments greatly with aqua fortis, and burns to a browniſh red. It is common on the ſhores in Yorkſhire.

The Soft Whitiſh STONE, with browniſh yellow partitions, is of a very ſoft and looſe conſiſtence, and full of great numbers of empty cracks. It is ſeldom above eight inches in diameter, and is of a roundiſh ſhape. Sometimes it is inveſted with a cruſt a little paler than the inſide of the Stone, and when broken a few ſhining ſpecks may be ſeen. It ferments greatly with aqua fortis, and calcines to a pure white.

The Elegant Cruſtated STONE, with a bluiſh nucleus or kernel, is of a very cloſe even texture, and is generally about eight or ten inches in diameter, and of a roundiſh flattiſh ſhape. The cruſt is about the ſixth of an inch thick, and of a pale yellowiſh brown, as well as the reſt of the maſs. The nucleus in the centre is uſually about four or five inches broad, and about half an inch in diameter. It is of a pale bluiſh grey, and round it the ſubſtance is diſpoſed in regular cruſts, which grow thinner as they approach the centre. It ferments with aqua fortis, and burns to a pale red. It is not very common; but is found in Leiceſterſhire.

The Hard Duſky Brown STONE, with very thick partitions, has a fine cloſe texture, and an even ſurface. Its ſhape has a tendency to roundneſs, and is generally between four and five inches in diameter, with a pale yellowiſh brown cruſt, though ſometimes it has none at all. When broken the ſurface is irregular, and looks like flint; but it has few ſpangles. The partitions are numerous, broad and thick, of a pale brown colour, and pretty tranſparent. They are all irregular, and this Stone will bear a pretty good poliſh. It will not ſtrike fire with ſteel, but ferments moſt ſtrongly with aqua fortis.

The Hard Greyiſh Brown STONE, with thick whitiſh partitions, is different from all the foregoing; for it is divided into angular ſquares of irregular ſhapes. The texture is firm and compact, and the ſurface irregular and rugged. The ſize is from four to eight inches, and it has a tendency to roundneſs. It ſeldom has a cruſt, and when broken does not at all ſparkle. It may be generally obſerved, that in theſe ſort of Stones the ſofter they are, the more they are ſpangled; but the harder, the leſs ſpar they contain. This ſtone is very heavy, and takes a good poliſh; but will not ſtrike fire with ſteel, though it ferments violently with aqua fortis.

The Brown Compreſſed STONE, with yellow partitions, is generally of a very large ſize, it being from one to three feet in diameter. It is of a broad and flat ſhape, and ſeldom above four inches thick. It is ſometimes inveſted with a thin yellowiſh brown cruſt, but is moſt commonly found naked. It has a reddiſh caſt, which is owing to a ſlight tinge of iron, though the prevailing colour is a pure brown. It has a ſmooth ſurface when broken, but has no ſhining ſpecks. The partitions conſiſt of fine glittering ſpar of the colour of honey, which is diſpoſed into columns, and is regularly and beautifully diſperſed throughout the maſs of the ſtone, dividing it into oblong angular pieces with three or four ſides, and from one to two inches in diameter. It is very heavy, hard, and will bear a fine poliſh; but will not ſtrike fire with ſteel, though it ferments violently with aqua fortis. It is common on the ſhores of Yorkſhire, Suſſex, and Kent.

The Whitiſh Grey and very Hard STONE, looking like flint, is of a firmer texture than any of the former, with a pretty ſmooth even ſurface. It ſeldom exceeds ſix inches in diameter, and is always of a round or oval ſhape. It is moſtly covered with a thickiſh brown cruſt, and on the inſide it is ſometimes very pale, and ſometimes mixed with more or leſs brown. It appears like flint when broken, and has no ſhining ſpecks. It has but few partitions, and thoſe very thin, and of a very pale browniſh white. It is remarkably heavy, and very hard, though it will not ſtrike fire with ſteel; but ferments violently with aqua fortis, and burns to a pale greyiſh white. It is not very common.

Bluiſh STONE, brown on the outſide, with white partitions, is pretty hard, with a rough irregular ſurface; and is of various ſizes, from a few inches to two feet in diameter. It is always flattiſh, being ſeldom more than ſix inches thick in the middle, from whence it becomes thinner to the edges every way. It is ſometimes inveſted with a pale brown cruſt of earthy matter, mixed with a little ſpar; but is moſt commonly entirely naked. Wherever this ſtone breaks with eaſe, it is always of a pale brown, but elſewhere of a duſky blue or lead colour, with a few ſhining ſpangles. The partitions are of a very pure white, though ſometimes a little tinged with the colour of brimſtone. They are very numerous, and divide the maſs into many pieces, which conſiſt of ſeveral ſides, and are from one to three inches in diameter. It is capable of a good poliſh, but will not ſtrike fire with ſteel, though it ferments violently with aqua fortis, and burns to a pale duſky red. This ſtone is very uncommon.

Hard Pale Yellow STONE, with a few thin partitions, is of a pretty firm texture, but the ſurface is rough and unequal. It is ſometimes three feet in breadth, and very flat, for it ſeldom exceeds two or three inches in thickneſs. The pale yellow is ſometimes mixed with brown, and when broken its ſurface is pure and regular. It has a few ſhining ſpangles in different places, and is ſometimes covered with a thin ſhell of a pale grey earthy matter. The partitions conſiſt of a pale brown ſpar, diſpoſed in ſhort irregular columns, and generally lie in

ſtraight perpendicular directions, dividing the maſs into large pieces; and on each ſide of the cracks filled with theſe partitions there is often a coat of white ſparry earth; for which reaſon this ſtone may be eaſily divided into pieces. It is pretty heavy, and will bear a tolerable poliſh. It is common in the middle counties of England.

A Soft Duſky Yellow STONE, with very thick partitions, has a pretty ſmooth texture, but not very compact: the ſurface is uneven, and the ſize is from two inches to two feet in diameter. It is always flattiſh, though generally thickeſt towards the centre, and thinner at the edges. When it has any cruſt, it is always a little ſofter than the reſt of the ſtone; and the diſagreeable duſky yellow is mixed with a little brown. When broken it appears in irregular flakes, with a rough ſurface, on which are a few ſpangles like talc. The partitions conſiſt of a pale yellow ſpar regularly diſperſed through the ſtone, and are pretty numerous, many of which are no leſs than one third of an inch in diameter. It is pretty heavy, though ſoft, and does not ferment greatly with aqua fortis. It may be ſeen in the clay pits near Deptford.

The Hard Bright Yellow STONE, variegated with brown, is of a pretty fine cloſe texture, with a very rugged unequal ſurface; and the ſize is from four to twelve inches in diameter. It is always oblong and flat, being no thicker in the middle than elſewhere. It has commonly a thick cruſt of the ſame ſubſtance with the ſtone, but ſofter; and is of a very bright beautiful yellow, with ſometimes a brown coat, and at other times veined in different directions. When broken, the ſurface is tolerably even, and there are ſhining ſpecks of ſpar in different places. The partitions are thin, but conſiſt of a pale brown ſpar. It is moderately hard, and will take a ſlight poliſh. It is common in the tile clay-pits about Pancras.

The Very Hard, Browniſh, Yellow, Undulated STONE, with a very few whitiſh partitions, is of a very even compact texture, with a ſmooth regular ſurface. It is from three to nine inches broad, of a flattiſh ſhape, and oftener ſquare than oblong. When broken it has a tolerably ſmooth ſurface, with long ſpecks of ſpar. The partitions are very few and ſmall, and it is often without any. It is very heavy, extremely hard, and will bear a fine poliſh; but yet it will not ſtrike fire with ſteel. It is common on Mendip Hills in Somerſetſhire.

The Hard, Greyiſh, Yellow STONE, is divided into pieces by thin yellow partitions, and has a very fine cloſe texture, but the ſurface is irregular and unequal. It has been found from four to twelve inches broad, of a roundiſh flat ſhape, and ſeldom with any cruſt. It appears ſmooth when broken, with a few glittering ſpangles. The partitions are of a fine pale honey-colour, and are very numerous, running among each other in all directions, and forming a ſort of net-work, ſomewhat like a honey-comb, but of various ſhapes. The pieces contained in theſe are about an inch in diameter, having from three to ſix ſides, and the partitions conſiſt of a tranſparent ſpar. The whole is very heavy, conſiderably hard, and will bear a good poliſh; but it will not ſtrike fire with ſteel. It is frequently met with on the ſea ſhore.

The Round Yellow Ferruginous STONE, with thin ſtraw-coloured partitions, has a ſmooth even texture, is about eight or ten inches in diameter, and in the ſhape of a round ball. It is always cruſted with a paler colour, which is ſofter than the ſubſtance of the Stone, and near an inch thick. The colour is a mixture of ruſty iron, and a pale yellow; and when broken the ſurface is ſmooth and even, with a few ſhining ſpar ſpecks that look like talc. The partitions are of a beautiful colour, and are compoſed of moſt bright pure ſpar, without any order. They are always thickeſt at the centre, and very few reach to the ſurface. It is conſiderably heavy, pretty hard, and will bear a ſlight poliſh. They may be ſeen in the clay pits between London and Iſlington.

The Roundiſh STONE, of a ruſty red colour, with yellowiſh partitions, is pretty like the former, and is between ſix and twelve inches in diameter. It is always covered with a thick cruſt, of a whitiſh brown clayey earth, containing a good deal of ſpar, and is commonly about half an inch thick. When broken the ſurface is even, and has a few ſhining ſpecks. The partitions are principally about the centre, and are of a fine bright yellow. It is very heavy, pretty hard, and will bear a tolerable poliſh. It may be ſeen in the clay pits near Iſlington.

The Ruſty Brown STONE, with whitiſh partitions, has a pretty ſmooth texture, but not very firm; the ſize is from two to twenty inches, and always broad and flat. It is generally covered with a thick whitiſh brown cruſt, and the ſurface when broken has many ſhining ſparry ſpecks. The partitions are pretty regular, running through the ſtone in perpendicular directions. It is ſo ſoft as hardly to bear any poliſh, and is common on the ſhores of Yorkſhire.

The Hard Blackiſh Brown STONE, with a yellow coat, has an exceeding fine texture, with a pretty even ſurface; and is from four to ſix inches in diameter, and always of an oval figure. The cruſt is of an ochreous clay, different from the reſt of the maſs, and is very brittle. It is commonly compoſed of thin coats laid evenly one upon another, and adhering but ſlightly. They are of a fine deep yellow, and are eaſily broken from the ſtone by a ſmall blow. The body of the ſtone is a mixture of ruſty colour and black, and when broken has a ſmooth flinty ſurface. The partitions are of a very pale yellow, and are pretty thick, dividing the ſtone into irregular pieces. This Stone is very common in many parts of the kingdom.

The Hard Brown STONE, with ſnow-white earthy partitions, has a very cloſe texture, with a pretty ſmooth and even ſurface. It is commonly of a roundiſh or oval ſhape, and from three to twelve inches in diameter. It is ſometimes naked, but oftener met with in ſtrata, covered with a thin brown earthy cruſt. The colour is of a pale brown, and when broken the ſurface is pretty ſmooth, with ſhining ſpecks of ſpar thereon. The partitions are ſoft and crumbly, and conſiſt of a white marl. It is very heavy, conſiderably hard, and will bear a very good poliſh; but will not ſtrike fire with ſteel. It is not very common, though it has been found in the counties of Somerſet and Huntingdon.

The Hard, Ruſty, Brown STONE, with yellow earthy partitions, is of a very firm compact texture, with a rough ſurface, and is generally flattiſh, and from four to ten inches broad. It has ſeldom any coat, but when it has, it is of a pale yellowiſh ſoft ſubſtance. The browniſh ruſt colour is commonly ſpotted and clouded with black, which ſometimes appears in the ſhape of ſhrubs, trees, and moſſes, like thoſe of the Mocha Stone. When broken the ſurface is ſmooth, and there are uſually no ſparry ſpecks. The partitions are narrow, few and irregular; theſe conſiſt of ochre and marl, of which the firſt is in the largeſt quantity. It is conſiderably heavy, hard, and will take a good poliſh, but will not ſtrike fire with ſteel. It has been found in Leiceſterſhire, Northamptonſhire, and near Highgate.

The Hard, Pale, Brown STONE, with partitions of a clayey earth, is of a cloſe firm texture, with a rugged ſurface, and commonly of a roundiſh or oval ſhape, and from four to twelve inches in diameter. It is often covered with a thin cruſt of a pale brown

colour, though it is ſometimes without it. When the ſubſtance of this Stone is broken, it appears with a coarſe ſurface of the ſame colour; but if according to the partitions, it is of the colour of ruſty iron. The partitions are of a clayey earth, tinged with iron particles; and they are irregular and few in number: beſides theſe there are exceeding fine cracks, in which places the Stone naturally breaks. It is very heavy, conſiderably large, and will bear a pretty good poliſh, but will not ſtrike fire with ſteel.

The Soft, Pale, Brown STONE, with partitions conſiſting of the ſame ſubſtance as the pyrites, is of a pretty coarſe and looſe texture, and ſomewhat porous, with a very ſmooth ſurface. Its ſhape is very uncertain, though moſt commonly roundiſh, or oval, and ſeldom exceeds ſix inches in diameter. When it is broad and flat it is moſt commonly naked; but when roundiſh, it has a thick whitiſh cruſt. The ſurface is irregular when broken, and has a taſte of vitriol, which none of the others have: the partitions are pretty numerous and irregular, but never thick, and conſiſt of a double plate of the vitriolic pyrites. This ſtone may be readily divided at theſe partitions, as well as the plates from each other, after it has lain ſome time in the air; for before that it will break more eaſily any where elſe. The ſubſtance is ſoft and brittle, and conſequently will not bear a poliſh.

The Ruſty Red STONE, with yellowiſh brown partitions, has a very fine compact texture, with a very ſmooth gloſſy ſurface. It is of various ſhapes, ſometimes oblong or oval, but more generally pretty much flatted, and is from three to twelve inches in diameter, and from four to ſix thick. Its colour is of a duſky browniſh red, not always perfectly mixed; for in ſome places they are almoſt diſtinct, and form a ſort of clouds or ſpots. When broken it appears to have an even gloſſy ſurface, without ſhining ſpecks. The partitions are many and pretty thick, with a ſtreaked texture, compoſed of an arrangement of browniſh yellow columnar ſpar, which is pretty hard, though not very bright. The pieces divided by theſe partitions are of different ſhapes and ſizes, and from half an inch to four inches in diameter. This Stone is very heavy, extremely hard, and will bear an exceeding fine poliſh. It will ſtrike fire with ſteel, but with great difficulty, and ferments briſkly with aqua fortis. It is very common in Yorkſhire, and in moſt of the northern counties of England.

The Browniſh Yellow STONE, with whitiſh partitions, is of a very firm texture, with generally a perfectly ſmooth ſurface. It is of various ſhapes and ſizes, and is ſometimes found in continued ſtrata, though more commonly in irregular ſhapes; but always compreſſed and flatted, from three to fourteen inches in diameter, and about five inches thick. It is met with on the ſea coaſt, particularly near Scarborough in Yorkſhire. They have ſeldom any cruſt, but when they have it is of a ruſty colour, and about a third of an inch thick. The colour of the ſtone is of a very fine ferruginous yellow, and when broken the ſurface is ſmooth and gloſſy, looking almoſt like flint. The partitions are numerous, and in many places thick and broad; they conſiſt of a ſemi-tranſparent ſpar, which is very hard, and by theſe the ſtone is divided into a multitude of irregular pieces, from one to four inches in diameter. It is very heavy and hard, and will ſtrike fire with ſteel, but with great difficulty.

The Bluiſh White STONE, with ſtraw-coloured partitions, has the ſame texture as the two former, with a rough rugged ſurface. It is generally found in looſe marſhes, of a flattiſh ſhape, with ſome tendency to round or oval; but generally with rough edges, and from four to eighteen inches in breadth, and from two to ſix thick. It has ſeldom or never any coat, and the colour conſiſts of a mixture of blue and white. When broken the ſurface is gloſſy, and without any ſhining ſpecks. The partitions are of a ſtreaked texture, and are compoſed of a fine tranſparent bright ſpar, with irregular columns. It is conſiderably heavy, pretty hard, and will bear a good poliſh. It ſtrikes fire with ſteel with great difficulty, and ferments briſkly with aqua fortis. It is common in Yorkſhire.

The Pale Yellow STONE, with a ruſty-coloured nucleus, is of a pretty cloſe compact texture, and of a roundiſh ſhape. It is about four inches in diameter, and is covered with a thin pale cruſt, within which there are from three to five coats of a different thickneſs, but all of the ſame ſubſtance, and much of the ſame colour, that is, of an agreeable pale yellow. When broken, the ſurface is pretty ſmooth, with many ſhining ſpecks of ſpar. Theſe coats have a nucleus or kernel in the centre, conſiſting of a hard ferruginous ſtone, and are divided from it by a thin regular partition of a ſtraw-coloured ſpar, from which there run a great many other ſtraight partitions directly to the circumference, but growing narrower as they come near it. It is pretty heavy, but not very hard, for it will not ſtrike fire with ſteel. The nucleus is of a different ſubſtance from the reſt, is very heavy, and of a firm texture; it ſtrikes fire with ſteel, but will not ferment with aqua fortis. It conſiſts of a large quantity of ferruginous matter, with a deep brown clay. It is to be met with on Mendip Hills in Somerſetſhire, and in a clay-pit near Iſlington.

The Browniſh STONE, with a blackiſh brown nucleus, is of a pretty fine cloſe texture, with a ſmooth regular ſurface, and is always roundiſh, though generally a little flatted. The ſize is two or three inches in diameter without any cruſt, and there is a hard blackiſh brown nucleus in the centre, of a cloſe texture, contained in a thin cruſt of a paler colour, but of the ſame ſubſtance. It is about half an inch in diameter, and the cruſt about an eighth of an inch thick. The ſtone is compoſed of two other coats nearly of the ſame thickneſs, and of different degrees of brown. They are divided from the nucleus by a fine thin partition of whitiſh ſpar, from which others run that are ſtraight towards the circumference, and yet but ſeldom paſs through the inner coat. The nucleus is hard and ſtony, but not ſo much as the former, for it breaks pretty eaſily, and is full of ſmall ſpecks of looſe ſpar. It conſiſts of earthy and ferruginous matter, and will ſtrike fire with ſteel, though with great difficulty, and will ferment a little with aqua fortis. It is to be met with in Northamptonſhire, Leiceſterſhire and Yorkſhire, and has been ſometimes found near London.

The Hard Whitiſh Grey STONE, with a brown nucleus, is of a very fine cloſe texture with a ſmooth ſurface, and is always roundiſh or oval. It is generally about two inches in diameter, and is covered with a pale whitiſh yellow cruſt. The nucleus is brown and covered with a cruſt as hard as itſelf, but ſomewhat of a paler colour, and on its outſide there is a fine ſparry partition, which is firm and hard; from this there generally runs three or four narrow partitions towards the ſurface, which ſeldom reach the outer cruſt. It is very hard, and capable of a good poliſh, but will not ſtrike fire with ſteel, nor yet the nucleus. It is a very uncommon ſtone, and hard to be met with.

The Small Ferruginous STONE, of a roundiſh or oblong ſhape, is generally known by the name of Mineral Bezoar, becauſe it has coats like Animal Bezoar. It has a cloſe, firm, compact texture, with a ſmooth ſurface, and is always either of a round or oblong form, generally about three quarters of an inch

inch in diameter, and from half an inch to two inches in length. They are conſtantly covered with a cruſt of a pale whitiſh ſubſtance of about a ſixth of an inch thick. They always conſiſt of a large central nucleus, ſometimes ſurrounded with two or three coats of ferruginous matter, and ſometimes irregularly blended with it, making together a ſingle nucleus ſurrounded with a cruſt. Both the nucleus and the cruſt are generally divided into three, four or five parts, by pretty large cracks, which are wideſt on the outſide, and uſually become narrower as they approach the centre. They are commonly empty towards the ſurface, but near the centre they are filled up with a fine tranſparent ſpar. The Stone itſelf is pretty hard, and will bear a pretty good poliſh. It will hardly ſtrike fire with ſteel, and ferments but very little with aqua fortis. It is common in the brick and tile clay-pits in all parts of England.

The Oblong, Pale, Brown STONE, with a long hollow nucleus, is of a very cloſe firm texture, with a rugged unequal ſurface. The ſhape is oblong and cylindric, only it is largeſt in the middle, and becomes gradually leſs towards each end; but for half an inch they each terminate in a ſmall cylinder of almoſt a whitiſh colour, and of a harder ſubſtance than the other parts. This is nothing but a lengthening of the inward ſubſtance, being only the extremity of the nucleus. It is between ſeven and eight inches long, and yet the diameter is three inches where thickeſt. The nucleus conſiſts of a long cylindric tube, terminating in a blunt point at each end, which is ſometimes empty, and ſometimes filled with a white marl, or the matter of the ſtone that contains it. It is of a ferruginous colour, and is incloſed in a thin cruſt of a browniſh ſubſtance, which is ſurrounded with a ſingle, double, or triple partition of beautiful ſpar, and this again with two thick cruſts conſiſting of the ſame ſubſtance as the reſt of theſe ſtones. It is divided by three or four partitions, running like rays from the circular partition ſtraight towards the circumference, but they generally vaniſh in the firſt and ſecond coat. The whole is ſurrounded with an unequal whitiſh brown coat about a third of an inch thick. The cavity of the nucleus is half an inch in diameter, and the nucleus itſelf about an inch. This Stone is ſubject to a great number of cracks lying in different directions, ſo that when ſtruck it will fall into many pieces, not more than the tenth of an inch in thickneſs each. The nucleus is very heavy and hard, but will not ſtrike fire with ſteel, any more than the body of the Stone. The partitions conſiſt of a pure white ſpar, which appear very bright when juſt broken. It has been found hitherto only in a great tile clay-pit near Oxford road, about three quarters of a mile beyond Tyburn.

The Very Hard Smooth STONE, with yellow, brown, and red coats, has a very fine compact texture, with a pretty ſmooth ſurface, and is remarkably heavy. Its ſhape is roundiſh or oblong, and the ſize is from a quarter of an inch to three or four inches in length; but moſt commonly of the ſhape and ſize of a pigeon's egg. It is ſometimes found naked with a ſomewhat gloſſy ſurface, and at other times covered with a whitiſh cruſt. It conſiſts of five or ſix coats, which incloſe a firm ſolid hard nucleus of the ſame ſubſtance, that is ſometimes of a deep duſky brown, and ſometimes of a ſtrong though not bright red; at other times it is compoſed of both theſe colours, either blended or in ſpots. The coats are alternately browniſh, yellowiſh and reddiſh, that next the nucleus being brown, the next yellow, and the third reddiſh, with another that is yellow, and over theſe one that is brown. However, they ſometimes vary in the diſpoſition. It is very common in clay and gravel-pits, and particularly about London, when covered with a cruſt. One fourth part of this Stone is iron.

The Hard, Glittering, Rough STONE, with brown, purple, and deep yellow coats, is of a coarſe, uneven, and very irregular texture. The ſhape is always oblong, but of different lengths and thickneſſes; it is from half an inch to eight inches long, and about three quarters of an inch in diameter. It has a rough ſurface made up of ſmall prominences and cavities, leſs than the heads of the ſmalleſt pins; but this is uncommon, for it is uſually ſtuck full of ſmall pebbles. It is pretty hard, and breaks with a rough ſurface, and there is a nucleus ſurrounded with eight or ten coats, ſome of a paler, ſome of a deeper brown; others of a duſky and ſomewhat reddiſh colour, and others again of a deep browniſh purple; but they are placed without any order or regularity. It is pretty bright and ſparkling, not only when juſt broken, but on the ſurface; and the whole ſubſtance of the coats is full of ſmall ſhining ſpangles like talc. It is common in the gravel-pits about Oxford, as well as in other places, and contains a ſmall quantity of iron.

The Soft, Browniſh, Yellow STONE, is almoſt as ſoft as earth, but is very compact, of a ſmooth texture, and conſiderably heavy. It is of a flattiſh oblong ſhape, and round at the ends; and is moſt commonly four inches long, two broad, and one thick. It is oily to the touch, and breaks with an irregular but ſmooth ſurface. It contains a nucleus of the ſame ſhape as the ſtone, and of the ſame colour, ſurrounded with coats of the ſame, which are extremely thin and exceeding numerous. It has no cruſty covering, nor does it at all ſparkle. It ferments very briſkly with aqua fortis, and burns to a beautiful pale red. It is very uncommon, but has been ſeen in the potters clay-pits in Staffordſhire, and in the foreſt of Dean.

The Soft STONE, with ſhining brown and duſky green coats, conſiſts of a coarſe opaque ſubſtance, and is of a looſe texture. It is remarkably heavy, of an oblong ſhape, and commonly about an inch and a half in length, ſomewhat in the form of a ninepin. It is harſh and rough to the touch, the ſurface being extremely uneven, and when broken it has an irregular and pretty rough ſurface. It is generally compoſed of four coats, ſurrounding a nucleus of the ſame ſubſtance and ſhape as the ſtone. This is ſurrounded by a brown broad coat, and that by another that is broader. The next is a very beautiful one, it making a fine glittering appearance, and is of a very pale brown colour; over all there is a coat of duſky brown clay, which is always rugged and unequal. It is very common in clay-pits in many parts of the kingdom, and particularly in a clay-pit near London behind Black-Mary's-Hole.

The Soft STONE, with ſhining, whitiſh, yellowiſh and red coats, is of a looſe brittle texture, and moderately heavy. It is commonly oblong, rounded at the ends, and of the ſize of a pigeon's egg. It is very rough, and will readily break with a ſmall blow; it has from four to ſix coats of the ſame looſe texture, but of different colours; but there is always one that ſparkles, and is compoſed of the matter of the common ſelenites. The nucleus is commonly whitiſh, though ſometimes with a mixture of yellow, and is of the ſame ſhape with the ſtone. The coat which immediately ſurrounds the nucleus is generally yellow, the next red, and the next whitiſh; then one that is yellow, and over theſe is the outermoſt, which is compoſed of great numbers of ſmall columnar ſelenites, that together appear almoſt like cryſtal. It is very common in the clay-pits of Northamptonſhire, and may be met with in ſeveral other counties.

CHAP. XXVIII.

Of the Harder Common STONES.

THE Hard, Shining, Black and White STONE, is of a very irregular ſtructure, but extremely firm, with a ſmooth though not gloſſy ſurface. It is from eighteen to twenty-five inches in diameter; but of different ſhapes, which all tend to be round, oval, or flat. At firſt ſight it appears to be only of a dull yellowiſh white, and a gloſſy black. The white ſpecks are ſometimes ſlightly tinged with a fleſh colour, others are of a cream colour, and others again ſhine like pure cryſtal. The ſurface is of a dull dead colour, but it is very bright and ſparkling when juſt broken. It is conſiderably heavy, very hard, and will take an excellent poliſh. It ſtrikes fire with ſteel, but will not ferment with aqua fortis. It is common on the ſhores of the iſland of Guernſey, and is met with in many places on the Engliſh coaſt. It is uſed in paving the ſtreets of London.

The Hard, Shining, Red and White STONE, is of much the ſame texture as the former, but of a better colour, and the ſhape tends to roundneſs or an oval. It is found often of twenty or thirty inches in diameter, with a very ſmooth ſurface; and the colour is a pleaſant light red, and ſometimes a fleſh colour, interſperſed with ſmall parcels of a pure bright white, from one eighth to one fourth of an inch in diameter. When broken it is ſmooth, bright, and beautiful; and is ſo hard that it will bear a very fine poliſh, as well as ſtrike fire with ſteel. It is brought from the ſhores of Scotland, and is uſed in London for paving the ſtreets.

The Red STONE variegated with white and black is of the ſame texture with the two former, and has a ſmooth, bright, gloſſy ſurface. Some are eight inches in diameter, and the ſhape is generally oblong and flattiſh. The colours are all beautiful and bright, the ground being red, variegated with all the different degrees and forms of a white tranſparent and black cryſtalline talc, which are ſo various in different ſtones, that they do not ſeem to be of the ſame kind. It is conſiderably heavy and hard, will take a fine poliſh, and ſtrike fire with ſteel. They are found on the ſhores of Guernſey iſland, and brought to London to pave the ſtreets, where they may be eaſily diſtinguiſhed by their ſurfaces after a ſhower of rain.

The Hard, Heavy, Greyiſh Black STONE, variegated with white, is of a more rude, irregular, and harſh texture than any of the former, though it is more compact and hard. The ſurface is ſmooth and even, but not gloſſy, and is generally about ten or twelve inches in diameter; but the ſhape is uncertain, though it is commonly flat on one ſide. It is not ſo beautiful as the former, being of a greyiſh or bluiſh black, with opake but very bright white, diſtinct from each other, yet regularly intermixed throughout the whole ſtone, ſo that it ſeems to conſiſt of a regular mixture of black and white. When freſh broken the ſurfaces are remarkably ſmooth and bright, and it will bear a high poliſh. It ſtrikes fire with ſteel, but will not ferment with aqua fortis, nor ſuffer any great alteration by fire. It is found on many parts of the ſhores of Yorkſhire, and is ſometimes ſeen in the ſtreets of London.

The Browniſh Red STONE, variegated with white and yellow, is of a pretty even fine texture, ſometimes from three to four feet in diameter, and of a ſomewhat oblong and flattiſh ſhape. The ground is of a reddiſh brown colour, which is variegated with an impure talcky cryſtalline matter, generally about an inch long and half an inch in diameter, that is either of a pure or yellowiſh white; and theſe variegations are often four or five inches diſtant from each other. It is pretty hard, will take a good poliſh, and ſtrike fire with ſteel, but does not ferment with aqua fortis. It is found on the ſurface of the earth in Yorkſhire and other counties.

The Reddiſh White STONE, variegated with black and gold colour, is of a more looſe texture than any of the former, and very coarſe. It is generally found between four and eight inches in diameter, and is of a very irregular ſhape, being ſeldom round, oval or flat. The colour is either a pale fleſh, a deeper red, or entirely white. The particles of which this ſtone is compoſed ſeem to be a cryſtal debaſed with earth, and more or leſs of a metalline tinge, of the ſize of a horſe-bean. Among theſe, black and yellow variegations are diſperſed, which are compoſed of cryſtal, earth, and talc, of different degrees of brightneſs. It is conſiderably hard, very heavy, and capable of taking a fine poliſh. It is common on the ſhores of Yorkſhire.

The hard White STONE, variegated with brown, is of a very coarſe harſh texture, but extremely firm and hard, with a ſmooth gloſſy ſurface. The ſize is from two to ten inches in diameter, and it is generally of a roundiſh or oval ſhape. The ground is of a duſky white, variegated with pale brown; but they are diſtinct from each other, and interſperſed with a great many flakes, ſome of which conſiſt of a pure cryſtal lined with talc. When freſh broken, it glitters very much, eſpecially in the white parts; it ſtrikes fire with ſteel, but will not ferment with aqua fortis. It is common in Weſtmoreland and Yorkſhire.

The Bluiſh, White, Bright, Brittle STONE, contains more talc and leſs cryſtal than the former; for which reaſon it is of a flaky texture, though very irregular, and the ſurface is rough and uneven. It is from ten to fourteen inches in diameter, and of a very uncertain ſhape, being generally rough and jagged at the ends and edges. Its colour conſiſts of a dark bluiſh grey, and a pretty pure opaque white; the former of which is the ground, though ſometimes it happens otherwiſe. It is compoſed of different maſſes, as in the other kinds; and thoſe that are ſtony or cryſtalline are much of a ſize, and ſeldom larger than a horſe-bean. It is but light in compariſon of the reſt, and is very brittle. It does not at all ſeem proper for poliſhing, though its ſtony parts will ſtrike fire with ſteel; but it will not ferment with aqua fortis, and when burnt it is whitiſh with a ſilvery gloſs. It is common in Yorkſhire and the neighbouring counties, where the common people make uſe of it in the winter nights to keep the bed warm, or rather their feet, to which it is laid after it has been heated; for it will retain the heat a conſiderable time; and they give it the name of the Warming-Stone.

The Brown Brittle STONE, variegated with yellow, is very beautiful, with a pretty fine even texture, but more looſe than the former, and with a rough ſurface occaſioned by prominences and cavities. It is of various ſizes, but ſeldom exceeds ſix inches in diameter; and the ſhape is quite irregular, though it is ſometimes flat, and tending to an oval. The diſtinct parts of which it conſiſts are ſeldom above one twelfth of an inch in length; and they are all of the ſame colour in the ſame maſs, which is of a pale brown; among theſe are a great number of talcky flakes that are extremely bright, which are ſometimes intermixed with ſpangles of black and whitiſh talc; but they are ſo uncommon, that brown and yellow may be ſaid to be the true colours of the ſtone. When broken it appears extremely beautiful; but it is ſo ſoft as not to be capable of a good poliſh, and therefore will not readily ſtrike fire with ſteel. It is found in many parts of Suſſex and Yorkſhire, and has been ſeen on Hampſtead Heath.

The Hard, Purpliſh, Brown STONE, variegated with white and yellow, has a very rough, coarſe, uneven texture; but it is firm and hard, with a rough unequal ſurface. It is commonly found from ten to eighteen inches in diameter, and the ſhape always approaches to round or oval, with a ſmoothneſs or flatneſs on one ſide. The colours are generally brown and white, or brown and yellow. The browniſh purple parts make the ground, and conſiſt of conſiderably large pieces, that are perfectly opaque. Thoſe that are white and yellow are ſmaller, more bright, and in ſome degree tranſparent, they being compoſed of a mixture of cryſtal and talc. It is a little bright when freſh broken, and is very hard; for it will readily ſtrike fire with ſteel. It is common on the ſhore near Scarborough, and has been ſometimes ſeen in the ſtreets of London.

The Hard Bluiſh Green STONE, variegated with white, is the moſt beautiful of the whole claſs. It is of a pretty firm, fine, but unequal texture; and in many places is looſe, irregular, and porous. The ſurface is very ſmooth; the uſual ſize is from three to four inches; and it is of a round or oval ſhape, but always flatted on one ſide. The greeniſh particles, of which the Stone chiefly conſiſts, are all of a cryſtalline ſubſtance debaſed with earth, and tinged with metalline particles. Its variegations are ſmall maſſes of white, conſiſting of cryſtal and talc, and debaſed with very little earth. It is very beautiful when broken, and is extremely heavy and hard; but it will not admit of a perfect poliſh, becauſe its texture is a little porous: however, it readily ſtrikes fire with ſteel. It is found on the ſhores of Suſſex, but is moſt common in Wales, and contains a pretty deal of copper.

CHAP. XXIX.

Of STONES approaching to the Nature of Flint.

THE Yellowiſh White STONE, filled with pebbles, commonly called the Pudding-Stone, is of various ſhapes, according to the various pebbles it contains. It has been by ſome ranked among pebbles, but improperly; for they are no part of the Stone itſelf, which is a diſtinct ſpecies, and different from all others. The ſementitious ſubſtance is an opaque Stone, of a very fine, cloſe, and firm texture, with a pretty ſmooth ſurface on the inſide, though in the maſſes it is frequently very rugged and unequal. In ſize it is from that of a walnut to three or four feet in diameter, with ſome tendency to roundneſs. It is of a pale yellowiſh colour, and when broken the ſurface is ſmooth, even, and flinty. It is pretty heavy and very hard, and conſequently will take a very beautiful poliſh. It will readily ſtrike fire with ſteel, but does not ferment with aqua fortis. The pebbles contained in it are of various kinds and ſizes, from that of a pin's head to the bigneſs of a walnut. It is found in many parts of England, particularly in Hertfordſhire, and is uſed for the tops of ſnuff-boxes and other toys.

The Greyiſh White STONE, filled with pebbles, is finer and harder than the former, but is very opaque, and has an exceeding ſmooth gloſſy ſurface, for it reſembles a ſmooth ſpotted pebble. It ſeldom exceeds ten inches in diameter, and its ſhape is almoſt always roundiſh all over. The pale greyiſh white colour often contains more of blue than pure white, and the ſurface is very ſmooth when broken. When cut into thin pieces it is ſomewhat tranſparent, and is capable of a beautiful poliſh. It readily ſtrikes fire with ſteel, but will not ferment with aqua fortis. * It is almoſt always found in gravel-pits among flints and pebbles, and is uſed for ſnuff-boxes like the former.

The Red STONE, filled with pebbles, is of the ſame nature with the two former, and is very opaque, with a pretty coarſe texture and a rugged ſurface. It is found from ſix inches to four feet in diameter, and of very irregular ſhapes. The colour is a deep red, and ſometimes there are different ſhades in different parts of the ſame piece. When broken, it is ſcarce at all bright or gloſſy, and its fineneſs is generally in proportion to its colour, for it is greateſt where that is leaſt. It will readily ſtrike fire with ſteel, but will not ferment with aqua fortis. The pebbles it contains are of various ſizes and kinds, and not ſo perfectly joined to the maſs as in the other ſpecies; they are, however, not eaſily ſeparated from it, and therefore it is as fit for uſe as any of the former. It is common in Lincolnſhire, Derbyſhire, and Yorkſhire, but is ſeldom brought up to London.

The Browniſh STONE, filled with pebbles, is of the ſame kind as the former, but is more impure and coarſe. It is perfectly dull and opaque, with a rough harſh texture, but yet pretty firm; and the ſurface is rough, rugged, and unequal. It is from two to five feet in diameter, and is of a very irregular ſhape, though it ſometimes ſhews a tendency to roundneſs. The colour is always of a duſky brown, but in various degrees. It is not ſo heavy as the former, though it ſtrikes fire with ſteel. It contains very ſmall, as well as ſome large pebbles, which are generally a little flattiſh. It is common in Leiceſterſhire.

The Fleſh-coloured STONE, filled with reddiſh impure cryſtalline nodules, is of a coarſe, harſh, looſe texture, and ſomewhat porous, with a rough irregular ſurface. It is found from four to twelve inches in diameter, and the ſhape is almoſt always flattiſh. It is generally ſo full of the maſſes it contains, that it is hard to find a ſpeck of the pure cement of the bigneſs of a pea. Its colour is a very pale whitiſh red, and the ſurface when broken is uneven without any gloſs. It ſtrikes fire with ſteel, though not without ſome difficulty; but does not ferment with aqua fortis. The nodules are all of the ſame kind, but of various ſizes, from the bigneſs of a pin's head to an inch in diameter. There is a great number of them, and they lie in different directions. Thoſe that are large are eaſily ſtruck out of the cement, leaving a pretty ſmooth cavity behind. Theſe nodules conſiſt of a ſort of cryſtalline particles. This Stone is common in the ſides of hills in Yorkſhire.

The Bluiſh Glittering STONE, filled with white impure cryſtalline nodules, is of a pretty coarſe, harſh, uneven, and irregular texture, with a rough ſurface; and is of various ſizes, from one foot to four or five in diameter, and generally of a flattiſh ſhape. The colour is a deep duſky blue or lead colour, and there are many bright glittering ſpangles. The ſurface is roughiſh when broken, and it ſeems to be a-kin to ſome of the lime-ſtones. It is very heavy, moderately hard, and capable of a very good poliſh. It readily ſtrikes fire with ſteel, and ferments a little with aqua fortis. The cryſtalline maſſes are the ſame as thoſe in the former Stones, only they are without any colour. It is found in many parts of Leiceſterſhire, as well as on the ſhore near Scarborough; but is never put to any uſe.

The Whitiſh Green Beautiful STONE, filled with cryſtalline nodules, has a pretty fine, cloſe, firm and hard texture, with a rugged unequal ſurface, without the leaſt gloſs or brightneſs; and the cryſtalline nodules generally ſtand pretty far out of their cement. Its ſize is from two inches to two feet in diameter, and its ſhape is generally flattiſh, ſeldom inclining either to round or oval. The colour is a pale whitiſh grey, irregularly tinged with a very beautiful

beautiful green; though it is not diffuſed through the whole Stone, but appears in the form of ſpecks and clouds. It has a rough and wrinkled ſurface when broken, without the leaſt tranſparency; and in breaking of it the nodules get out of their places, leaving cavities behind. They are generally ſmooth, but not gloſſy; and they ſeldom exceed the ſize of a ſmall pea. They are outwardly of a very deep green, but within are white and opaque. They conſiſt of a tabulated ſpar, and the green colour is owing to the maſs in which they are included. This ſtone is moderately heavy and pretty hard; but it will not take a good poliſh, nor yet ſtrike fire with ſteel without difficulty. It is found on the ſhores of Minorca, and now and then on the Engliſh coaſt.

The Brittle, Pale, Red STONE, variegated with white veins, and containing red nodules, is the ſofteſt and moſt brittle of this claſs, with a coarſe looſe texture, and a rough irregular ſurface. It is of various ſizes, for it has been found from one to thirty inches, and is always flattiſh. The red colour is different in different maſſes, it being ſometimes of a brick colour, while other parts are of a pale fleſh. When broken, it is in many places perfectly ſpungy, without the leaſt brightneſs, except in the white veins, which are not many. The red nodules are from the ſize of a pin's head to that of a hazle nut, and conſiſt of the ſame ſubſtance as the ſtone itſelf. The ſtone is not proof againſt water, and will ſcarce give fire with ſteel. It is common in the ſhores about Scarborough.

CHAP. XXX.

Of Flinty STONES.

THE Common FLINT is a ſtone univerſally known, and of a very fine compact texture, with a ſurface that is generally rough and rugged, with various protuberances. The ſize is different, from an inch to two or three feet in diameter. The ſhape is extremely irregular, it being in gravel-pits of the form of a common pebble; but in chalk, where it is found in greater plenty, it is met with in all ſhapes. It is always covered with a white cruſt, which is ſometimes very thin, and ſometimes one ſixth of an inch thick. It conſiſts of cryſtal, debaſed with a large mixture of white earth, of the clay kind. The ſubſtance of this ſtone is uniform and equal, and is generally blackiſh, though ſometimes grey. When broken it is of a fine even gloſſy ſurface, is ſemi-tranſparent, and will bear a fine poliſh. It is met with in all countries, and is put to various uſes.

The White Flinty STONE is pretty fine, with a ſmooth compact texture, and a ſmooth ſurface, only it is furrowed with ſhallow wrinkles. It is generally roundiſh, but ſometimes oblong, and its ſize is from half an inch to eighteen inches in diameter. The colour is uniform throughout, which is always white, with a ſmall bluiſh caſt. It is not equally pure, nor of the ſame degree of tranſparency; for ſome reſemble the white cornelian, and others the common ground of agate. The coat is ſometimes a little reddiſh, but is more commonly grey, or of a greyiſh brown. When broken it appears to have a fine even flinty ſurface; and, as it is very hard, it will bear a good poliſh. It will readily ſtrike fire with ſteel, but will not ferment with aqua fortis. This is a common ſtone in many parts of England.

The Red Flinty STONE is of a very fine firm texture, with a ſurface not ſo even as the former; for it has deeper wrinkles, and often many prominences and cavities in different parts. It is generally roundiſh, and from an inch to three inches in diameter. It is naturally uniform, being without ſpots, clouds, or ſtreaks, and its colour is very fine, but it is of different degrees of red in different ſtones, as well as of different degrees of purity. It has ſometimes ſmall, whitiſh, opaque ſpots, and ſome are brighter and more tranſparent than others. It often nearly reſembles the different cornelians, and has generally a whitiſh coat, with a ſmall mixture of aſh-colour, or yellowiſh brown. When broken, it appears to have a flinty ſurface, is very hard, and capable of a good poliſh. It ſtrikes fire readily with ſteel, but will not ferment with aqua fortis. It is very common in our gravel-pits, and many of the ſeals ſold for cornelian are made therewith.

The Yellow Flinty STONE is of a very fine even texture, and is extremely firm; but the ſurface is rough and irregular, it being full of wrinkles and other inequalities, and the ſhape is generally rugged and unequal. The ſize is from one inch to ſeven in diameter, and it conſiſts of cryſtal, debaſed with a yellow earth, to which it owes its colour. They are ſometimes of a deep yellow, and ſometimes inclining to a whitiſh grey. It reſembles the yellow cornelian, and is often equal to the fineſt ſtones of that kind; but is ſometimes ſubject to imperceptible flaws, which will make it fly to pieces when broken. However, the ſurfaces are fine and gloſſy, and it is more tranſparent than the former: as it is very hard, it will take a fine poliſh. It readily ſtrikes fire with ſteel, but will not ferment with aqua fortis. It is not very common, but has been found on Hampſtead Heath.

The Bluiſh Flinty STONE is of a pretty ſmooth and cloſe texture, with a rough irregular wrinkled ſurface and a very uncertain ſhape. It is generally about two inches in diameter, and is not of ſo ſimple a colour as the former; for it is of different degrees of blue in the different parts, ſome of which are deep, and others approaching to white, appearing in clouds, ſpots, and ſhort lines. It is without cavities or cracks, and its outer coat is of various colours, but generally with a white and chalk-like appearance; ſometimes it is of a bluiſh brown, and ſometimes very thick and yellow. It is pretty hard, will take a good poliſh, and freely ſtrike fire with ſteel. It is very common in gravel-pits.

The Greeniſh Flinty STONE is not ſo cloſe and compact as the former, nor yet ſo fine, though the ſurface is pretty ſmooth and even. It is generally of a roundiſh or oblong ſhape, and from half an inch to two inches in diameter. It is always of the ſame colour, without either ſpot or cloud, which is of a deep duſky and ſomewhat bluiſh green. It is ſometimes of the colour of green jaſper, but has a coarſe look, as it contains a great deal of earth. The coat is generally thick and white, and ſometimes of a bluiſh duſky grey. When broken the ſurface is even, and as it is very hard, it will bear a good poliſh. It readily ſtrikes fire with ſteel, but will not ferment with aqua fortis. It is not very common, and conſequently is but ſeldom found.

CHAP. XXXI.

Of STONES that outwardly appear like PEBBLES.

THE Stone called PEBBLE CRYSTAL has a very ſmooth equal texture, it being in reality nothing elſe but Cryſtal in this form. It is free from all mixtures, and is found from the ſize of a pin's head to twelve inches in diameter. It is generally pretty round, though ſometimes not without irregularities on the ſurface, and is ſometimes flattiſh. It has a cloſe firm texture, is pretty heavy, and as tranſparent as water. It is very hard, is capable of a very

a very high poliſh, and when broken is very bright and glittering. It ſtrikes fire with ſteel, but does not ferment with aqua fortis. They are found almoſt in all parts of the world; but are moſt common in America, where they are very large, and are generally known here by the name of Braſil Pebbles. They are found in that country on the banks of rivers, as well as in Germany, Italy, and France. They are alſo met with in England; but their ſize is very ſmall. Spectacles are made with this ſtone.

The Purple, Half-tranſparent, Cryſtalline STONE, has a rough uneven texture, but it is very firm, with a ſmooth ſurface; it is generally between an inch and four inches in diameter, and of a roundiſh ſhape, a little flatted. It is of an unpleaſant yellowiſh white on the outſide, but is pretty heavy, and when broken the colour is a reddiſh purple, very bright and glittering. The colour is not uniform, but appears ſometimes in blotches, and ſometimes in veins, in ſuch large quantities, that they ſeem to tinge the whole maſs. It is not quite ſo hard as the former, but will ſtrike fire with ſteel. This is found in rivers and gravel-pits, and has been brought from Germany and Bohemia. It is ſaid alſo to have been met with in gravel-pits near London.

The Snow-white, Opaque, Cryſtalline STONE, is of a very ſmooth, firm, and cloſe texture, with a ſmooth even ſurface: its ſize is generally between a quarter of an inch and two inches, and though it is ſometimes round, it is more frequently oval and flattiſh. It is as white as chalk on the outſide, is pretty heavy, and when broken the colour is bright and ſhining, and as white as ſnow. It conſiſts of a homogene ſubſtance, and is extremely hard. It freely ſtrikes fire with ſteel, but will not ferment with aqua fortis. It will take a very fine poliſh, and is common in the gravel-pits of Norfolk.

The Opaque, Whitiſh, Reddiſh or Yellowiſh Cryſtalline STONE, commonly known by the name of the red, white, and yellow ſparry Pebble, is the moſt common ſtone we have. It conſiſts of a rough irregular and opaque ſubſtance, which is pretty firm and compact in its texture, with a pretty ſmooth ſurface, though often full of cracks, which ſometimes penetrate deep into the body of the ſtone. It is met with from the ſize of a pea to ſix or ſeven inches in diameter, and is inclinable to a roundiſh ſhape, though it is ſometimes flattiſh, eſpecially on one ſide. The colour is much the ſame without and within, and it is irregularly tinged with different colours. Theſe are ſometimes uniform throughout the whole ſubſtance of the ſtone, but ſometimes appears in ſpots, blotches, and irregular veins. It has a little brightneſs when broken, and appears to be of a looſe texture. They are to be met with in gravel-pits and other places all over the kingdom.

The Yellowiſh, White, Spungy STONE, has ſomewhat of the nature of ſand-ſtones hewn out of quarries, inſomuch that it might be miſtaken for a fragment of that kind. The texture is coarſe, but pretty firm, though there are ſmall cavities that give it ſome reſemblance of a ſponge; the ſurface alſo has the ſame appearance, and it is generally from half an inch to two inches in diameter. It is pretty heavy, and more or leſs of a yellowiſh white, without the leaſt brightneſs. It is compoſed of an irregular cryſtalline matter, debaſed with a mixture of a whitiſh and yellowiſh opaque ſubſtance. Though it is pretty hard, it will not eaſily ſtrike fire with ſteel, nor does it ferment with aqua fortis. When examined with a microſcope it appears to be a petrified ſponge, for there are more cavities than ſolid matter.

The Hard, Porous, Whitiſh, Cryſtalline STONE has a rough cavernous and ſpungy ſurface; but it has not ſo many pores on the inſide as the former kind. There are veins on the outſide, diſperſed in an irregular manner, of different breadths, and often interwoven with each other; likewiſe they all ſtand up in ridges above the ſurface of the ſtone. Sometimes the pores on the inſide are wanting, which renders the texture the more firm; it is from one inch to ſix in diameter, and generally of a flattiſh ſhape, though ſomewhat roundiſh. It is naturally white, and ſometimes has a mixture of faint red, or pale yellow. It is pretty heavy, very hard, and is gloſſy when broken, eſpecially in its veins, which are more cloſe and compact than the reſt of the maſs. It ſtrikes fire with ſteel, but will not ferment with aqua fortis.

The Greyiſh, White, Opaque STONE, is of a very cloſe texture, with a ſmooth even ſurface; but it is ſubject to cracks of various ſizes, and is from an inch to a foot in diameter, ſometimes roundiſh, and ſometimes flat; but in this laſt caſe it is always ſubject to ſuperficial cracks. It is perfectly opaque and dull when broken, though it conſiſts of an uniform cryſtalline ſubſtance, debaſed by a mixture of white and grey clay. It is very heavy, pretty hard, and will readily ſtrike fire with ſteel. This, as well as the two former, is commonly in gravel-pits.

The Brittle, White, Sandy STONE, is of a very looſe brittle texture, with a pretty ſmooth regular ſurface, though it is ſomewhat rough to the touch; the ſhape is irregular, though generally flattiſh, and the ſize is from one to twelve inches in diameter. It is pretty heavy, and when broken appears of a bright glittering white. It conſiſts of a great deal of pure white ſand, to which it may be reduced, and it breaks with the ſlighteſt blow into a great number of pieces. It is readily penetrated by water, which will paſs through it unchanged. It will not ferment with aqua fortis. It is not very common, but has been found in the gravel-pits of Northamptonſhire.

The White Cryſtalline STONE, with yellow ſpecks, is by ſome called the Worm-ſeed Stone. It is of a pretty hard compact texture, and generally has a ſmooth ſurface, though ſometimes there are irregular cavities. It is of a roundiſh or oblong ſhape, and thicker at the middle than at the edges. It is commonly about three or four inches in diameter, and the colour is generally white, though it has ſometimes a pale brown caſt. The ſpecks are about the breadth of a ſmall pin's head, and are of a very bright pale yellow, by which characteriſtic it is eaſily diſtinguiſhed from all other ſtones. The colour is dull on the outſide, but bright and glittering when broken; and it conſiſts of a large angular grit, extremely well united. It ſtrikes fire with ſteel; but does not ferment with aqua fortis. It is common in Yorkſhire, and is ſometimes found in the gravel-pits near London.

Whitiſh, Brown, Dull STONE, is ſofter than any of the former, and yet the texture is pretty even and regular. It is generally above a foot in diameter, and its ſhape is always broad and flat, with deep longitudinal cracks on the ſurface, which are croſſed with ſome that are ſmaller. It is of a very pale brown, and has ſometimes a faint yellowiſh or reddiſh tinge. The ſurface is dull and opaque, and when broken is generally full of cracks, the largeſt of which are often filled up with cryſtals, which look very bright and glittering. It is pretty heavy, and is harder in ſome places than others. It is found in many parts of England, and particularly on Hampſtead Heath, very deep in the ground. It ſometimes contains large pieces of petrified wood, which are ſo ſtony that they cannot be perceived, except by the knots.

The Blueiſh, White, Hard, Cryſtalline STONE, is not of a very fine ſtructure, but firm and cloſe, with a ſmooth ſurface. It is generally from three to ten inches in diameter, and of a flattiſh ſhape, ſomewhat

what approaching to roundneſs. It is of a dull light lead colour on the outſide, but when broken is bright and gloſſy, and the thin pieces are a little tranſparent. It is very heavy, will take a fine poliſh, and readily ſtrikes fire with ſteel. It is very common on the ſhores of Italy, France, and England.

The Browniſh, White, Hard, Shining STONE, is pretty coarſe, but very firm, and has a rough irregular ſurface. It is about ſix or ſeven inches in diameter, though ſometimes much ſmaller, and at other times extremely large. It is of a duſky white on the outſide, with a ſmall mixture of pale brown; but when broken it is bright and glittering, with an unequal ſurface. It conſiſts of a grit with blunt angles, together with roundiſh bright particles, cemented together with a ſubſtance nearly as bright. It is ſometimes full of black and green ſpecks, of the ſize of very ſmall grains of ſand. It is pretty heavy, and capable of a good poliſh; but it will not ſtrike fire with ſteel. It ferments violently with aqua fortis, which diſcovers its nature, which is that of conſiſting pretty much of ſpar. It is found in Derbyſhire.

CHAP. XXXII.

Of Common PEBBLE-STONES.

THE Yellowiſh Green PEBBLE, with a bluiſh white cruſt, is of a fine cloſe texture, and the ſurface, though regular, is a little wrinkled. The ſhape is roundiſh or oblong, and the ſize from one to five inches in diameter. It has commonly a large nucleus in the centre, incloſed in a broad coat, which is covered with a very thin cruſt. The nucleus is of a greyiſh yellow, ſometimes perfectly blended together, and ſometimes irregularly mixed in the form of clouds or large ſpots. There are often white opaque ſpots diſperſed here and there, and the nucleus approaches to pure flint. The coat next to it is of a bluiſh white, and of a ſomewhat coarſer texture. The external cruſt is of a whiter colour, and is of the ſame ſubſtance, only there is a greater mixture of earth. When broken it has a ſmooth gloſſy ſurface, and the nucleus is pretty tranſparent. It is very hard, will bear a good poliſh, and ſtrikes fire with ſteel. It is found in the gravel-pits in Northamptonſhire, and ſometimes in thoſe near London; however, when found, it is of no value.

The Whitiſh, Grey, and Reddiſh Coated PEBBLE, with a yellow centre, is more beautiful than the former, and has a fine cloſe texture, with a pretty even ſurface, though full of wrinkles. It is of a flattiſh round ſhape, and the common ſize is about three inches in diameter. It is compoſed of a large nucleus, which is the principal part of the ſtone, and is of a deep bright yellow, and pretty tranſparent. It is ſometimes marked with roundiſh white ſpots, from the bigneſs of a pin's head to that of a pea, and is ſurrounded with a coat of a pale greyiſh white, of a flinty ſubſtance, which ſometimes receives the matter of the nucleus into itſelf in the form of clouds, making a broad undulated line. This is generally covered with a red coat, and that with the external cruſt, which conſiſts of a great quantity of earth. When broken it has a gloſſy ſurface, and is hard enough to take a poliſh. It is very common on Hampſtead Heath, and in many other places.

The White, Black, Brown, and Straw-coloured PEBBLE, with a yellow nucleus, is a very beautiful ſtone, and of a fine texture. It is generally of a roundiſh or oval ſhape, and ſeldom exceeds three inches in diameter. The nucleus is large, and is the principal part of the ſtone. It is ſurrounded with ſeveral coats, which reſemble the zones of the onyx. The nucleus is very bright, and pretty tranſparent, and of a deep but not bright yellow. It is ſometimes of the ſame colour throughout, and has clouds of a different yellow and flint colour, alſo opaque ſpecks of a paliſh white, and ſometimes likewiſe the centre is tranſparent cryſtal. The nucleus is uſually ſurrounded with a narrow black circular line, and is covered with a coat of a paler yellow than the nucleus, and that by another of an opaque white; the next is of a pale brown, beſides which there are four or five others of the ſame colours placed alternately. Theſe are all covered with a bluiſh cruſt, but ſometimes with a whitiſh, and always greatly wrinkled. When broken, the ſurface is gloſſy and pretty tranſparent, is very hard, and will bear a good poliſh. It ſtrikes fire with ſteel, but will not ferment with aqua fortis. It is common on Hampſtead Heath.

The Whitiſh, Bluiſh, and Brown PEBBLE, with a dull brown nucleus, has a cloſe firm texture, with an even ſurface, only it is wrinkled. It is generally of a roundiſh or oval ſhape ſomewhat flatted, and the ſize is from one to five inches in diameter. The nucleus is pretty large, of a deepiſh brown, and of a pretty fine texture, but not very tranſparent or bright. It is commonly ſurrounded with a broad whitiſh coat, then with a narrower of the ſame colour as the nucleus; after that is a third of the ſame ſubſtance with the inner coat, and theſe are covered by one of a bluiſh colour, of a more flinty texture than the other part of the Stone, over which there is a cruſt like the reſt, but more earthy. When broken the ſurface is very bright and gloſſy, and as it is pretty hard, it will bear a good poliſh. It is common on Hampſtead Heath, and in the gravel-pits about London.

The PEBBLE, with white and brown coats, and a ſhining brown nucleus, is a very pure and beautiful Stone, and has a fine cloſe texture, with the common wrinkled ſurface of other Pebbles. It is generally of a round or oval form a little flatted, and commonly four or five inches in diameter. The nucleus is very large and oblong, and of a deep bright pleaſant brown. It is tranſparent, though ſometimes ſubject to whitiſh ſpecks. It is ſurrounded with a coat of a milky white, ſometimes mixed with a little pearly blue; and next to that is one of the ſame colour with the nucleus, only it is not ſo tranſparent nor bright. Over this is the cruſt that covers the whole, and in general it is not inferior to an agate. When broken, it has a bright gloſſy ſurface, and where thin is pretty tranſparent; it is extremely hard, capable of a fine poliſh, and will ſtrike fire with ſteel. It is found in gravel-pits, but is not ſo common as the former.

The PEBBLE, with white, brown and yellow coats, with a ſmall browniſh yellow nucleus, has a fine cloſe texture, with the wrinkled ſurface of other Pebbles. It is commonly roundiſh or oval, and the common ſize is about an inch in diameter. The nucleus is about as big as a ſmall nutmeg, and is ſurrounded by a coat of a dull opaque impure white, and that with one of a pale whitiſh brown; the next is of a pale red or fleſh-colour, and the fourth of a blackiſh brown. The outer cruſt is a pale yellow, and as thick as any of the reſt. The nucleus is pretty bright, but has little or no tranſparency; however, this Stone, as well as all others, is ſubject to ſome varieties. It is very hard, will bear a fine poliſh, and readily ſtrikes fire with ſteel. It is pretty common in the gravel-pits about London, and might be put to good uſes by the lapidaries.

The PEBBLE, with greyiſh white, pale brown, and reddiſh coats, with a ſmall brown nucleus, is of a very fine cloſe texture, and has the wrinkled ſurface common to other Pebbles. The ſhape is roundiſh or oval, and is commonly four or five

inches in diameter. The nucleus is uſually of the ſize of a nutmeg, and of a deep brown colour. This is covered with a coat of a pale whitiſh grey, and that by another that is of the like but thinner, and next to theſe there are generally four or five of the ſame colour as the nucleus, and others of a very pale whitiſh brown alternately diſpoſed. It is more tranſparent than moſt other Pebbles, and when broken has a flinty ſurface; it is very hard, will bear a good poliſh, and ſtrikes fire with ſteel. It is common in the gravel-pits on Hampſtead Heath.

The PEBBLE with yellow, red, and bluiſh white coats, with a reddiſh brown nucleus, is of an exceeding fine firm texture, and is not ſo wrinkled on the ſurface as moſt of the other kinds. It is of a roundiſh flattiſh ſhape, and commonly about three inches in diameter; the nucleus is pretty large, of a very fine texture, and pretty bright and tranſparent. It is of a pale red, and is incloſed in a coat of a fine pearl colour or bluiſh white, which is pure, bright, and tranſparent; next to this is a fine red coat, and after that ſeveral pearl-coloured and red coats alternately placed; over theſe there are three or four coats of a pale yellow, and the outer cruſt is of a pale bluiſh colour. It is more tranſparent than moſt other Pebbles, and when broken has an even ſurface; it is very hard, will bear the higheſt poliſh, and readily ſtrikes fire with ſteel. It is common in the gravel-pits about Kenſington, and many other places. It is in ſome uſe with our lapidaries.

The PEBBLE, with white, orange, brown, and duſky yellow coats, and a brown nucleus, is of a very fine cloſe texture, with a wrinkled ſurface, like the reſt of the Pebbles. It is of a roundiſh or oval ſhape, and from one to three inches in diameter. The nucleus is ſmall, and the coat that immediately ſurrounds it is of a clear white. The next to that is orange, and then there are eight or ten of different colours, compoſed of brown or yellow, after which are colours of a duſky white, with a fine orange colour between them. The whole is very pure, bright and tranſparent, though it is ſubject to many variations. When broken it has a fine gloſſy ſurface, is extremely hard, and conſequently will bear a very fine poliſh. It is common in the gravel-pits on Hampſtead Heath, and in many other places about London.

The PEBBLE, with whitiſh, browniſh, and yellowiſh coats, and a brown nucleus, is of a more coarſe texture, than any of the former, though pretty firm and hard. The ſurface is more ſmooth than that of other Pebbles, and is generally pretty round, and between two and three inches in diameter. The nucleus ſeldom exceeds the ſize of a horſe-bean, and is ſurrounded by an irregular undulated coat, compoſed of others that are narrow; next to this are three or four others, which are compoſed partly of a very deep brown, with ſome that are yellowiſh, and others of a duſky pale blue. They have all a mean appearance, and are perfectly opaque. They are very ſcarce, and are of no value.

The PEBBLE, with yellowiſh, brown, and aſh-coloured coats, and a bluiſh white large nucleus, is a very beautiful ſtone, and has a fine firm texture with a wrinkled ſurface. It is generally roundiſh, and from one to four inches in diameter. The nucleus is large and very beautiful, and ſometimes makes the principal part of the ſtone. It is of an exceeding fine texture, and very bright and tranſparent, approaching to a white cornelian. It is of the colour of pearl with a bluiſh white, which is often debaſed with clouds, ſpots, and veins of an opaque white. This is ſurrounded with a yellowiſh brown coat that is clear and tranſparent, and then there is another of a pale aſh coloured grey as fine as the former: theſe are ſurrounded with the outer cruſt, which is of a bluiſh or aſh colour; however, the coats and the ſtones are met with in different proportions. It is more tranſparent than any of the reſt, is very hard, will take a fine poliſh, and ſtrike fire with ſteel. It is common in the gravel-pits on Hampſtead Heath, and about Windſor.

The PEBBLE, with fleſh coloured, brown, and bluiſh white coats, and a fine large white nucleus, has a fine, cloſe and firm texture, and the ſurface has only ſome ſlight wrinkles; the ſhape is roundiſh or oval, and generally about two or three inches in diameter. The nucleus is oblong, and not ſo blue as that of the former, but is as fine, bright and tranſparent. It is encompaſſed with a great number of coats of a pale brown, bluiſh white, and a pale white light red placed alternately, and covered with a whitiſh cruſt. They ſeem all to be of an equal degree of brightneſs and tranſparency; but it is ſubject to great variations. It is hard enough to ſtrike fire with ſteel, and will bear a very fine poliſh. It is common in the gravel-pits of Hertfordſhire, and is uſed in London to make tops for ſnuff-boxes.

The PEBBLE, with red, fleſh coloured and yellow coats, and a white nucleus, is a fine beautiful Stone, and of a very cloſe texture, with a wrinkled ſurface like that of other Pebbles. It is generally roundiſh, though ſometimes oblong, and is commonly about three inches in diameter. The nucleus is commonly pretty large and opaque, though of a very fine texture, and is frequently full of coarſe roundiſh white ſpots. This is commonly encompaſſed by a thin bright red coat, and that by one of a beautiful bright yellow, next to which there is another of a fleſh colour, and then four, five, or ſix others of the ſame colours, but not placed in an alternate order. They are all very bright, and more tranſparent than the nucleus. When broken, the ſurface is fine and ſmooth, is very hard, and will take an elegant poliſh, as well as ſtrike fire with ſteel. It is common in the gravel-pits on Hampſtead Heath.

The PEBBLE, with very thin, numerous, brown and yellow coats, and a greyiſh white nucleus, is of an exceeding fine cloſe texture, with a ſurface not ſo much wrinkled as in other Pebbles. It is generally of a roundiſh ſhape, and from one to four inches in diameter. The nucleus is large and of a fine texture, but not quite ſo tranſparent as the reſt of the Stone. The grey and the white are ſometimes diſtinct, and at others blended together; but is ſubject to ſmall grey opaque ſpots. The coats are many in number, but only of a pale browniſh yellow and a duſky brown colour placed alternately. They are bright, beautiful, very tranſparent, and covered with white opaque dull cruſts. It has a gloſſy ſurface when broken, is very hard, will bear a fine poliſh, and will ſtrike fire with ſteel. It is common among gravel in Hertfordſhire.

The PEBBLE, with brown, yellow and white coats, and a greyiſh white nucleus, is of a fine cloſe texture, with a rugged wrinkled ſurface; is generally oblong and flattiſh, and from one inch to five in diameter. The nucleus is ſometimes no bigger than a horſe-bean, though the Pebble be large; and yet it is ſometimes an inch broad in ſmaller. The ſurface is gloſſy, but very opaque, encompaſſed by many fine regular coats of a fine deep brown, a very pale yellow with a little mixture of brown, and a fine white. The brown is next to the nucleus, and the other colours are placed alternately, but tinged more than one at a time. Its ſurface is gloſſy when broken, and, as it is very hard, will bear a good poliſh, and ſtrike fire with ſteel. It is common on Hampſtead Heath, and in the gravel-pits about Iſlington.

The PEBBLE, with white, grey, and fleſh coloured coats, and a very white nucleus, is of an even

close texture, with a very rough wrinkled surface, and a flat roundish shape, from two to three inches in diameter. The nucleus is of various sizes, from the bigness of a pea to that of a walnut, and is of a fine texture, but opaque and dull, as are all the other colours. It is irregularly surrounded with many coats of different thicknesses and different colours. When broken, it has a smooth but not a glossy surface, and is so hard as to be capable of a good polish, and strikes fire with steel. It is common in the gravel-pits about London.

The PEBBLE, with brown, ferruginous, and yellow coats, and a browniſh white nucleus, is one of the coarſeſt of this kind; but the texture is hard and compact, and the ſurface is not ſo wrinkled as many others; however, there are ſeveral prominences and cavities, which render the ſhape irregular, though it is generally ſomewhat oblong. It is from one to four inches in diameter; and the nucleus is ſometimes ſo pale, that it is almoſt white. It is encompaſſed with four or five coats, whoſe colours are very good: that next the nucleus is of a ruſty coloured brown, the next to that pale brown; after which is another of a ruſty brown, then one of a deep yellow; the next is brown, and then comes the cruſt, which is of a pale whitiſh grey. It appears rough when broken, and is ſo hard as to ſtrike fire with ſteel. It is not very common, though it has been met with in different places.

The PEBBLE, with brown and grey coats, and a bluiſh nucleus, is of a very fine firm texture, with a ſmooth ſurface, and not ſo much wrinkled as many others. The ſhape is oblong, and from one to three inches in diameter. The nucleus is of a pure flinty ſubſtance, ſometimes of the ſame uniform colour, but more frequently veined or ſpotted with a lighter or darker colour of the ſame kind. This is encompaſſed with a fine deep brown coat, which is very bright; and that is ſucceeded by one of an aſh colour, as bright as the nucleus. The cruſt is next to theſe, which is pretty thick. It has ſomewhat more of a tranſparency than moſt of this kind; and as it is extremely hard, it is capable of a good poliſh. It is met with in ſome parts of Hertfordſhire.

The PEBBLE, with thick, whitiſh, and red coats, and a grey nucleus, is of a very fine texture, but the ſurface is rough, irregular, and deeply wrinkled. Its ſhape generally tends to roundiſh, and it is moſt commonly an inch and a half in diameter. The nucleus is hard, bright, gloſſy, and tranſparent; the next coat is uſually red, with a little mixture of ruſty brown, and is not ſo tranſparent as the other parts of the ſtone; next to this is a coat of a bluiſh white or pearl colour, very bright; after this comes the cruſt, which is thick, coarſe, of a very bright white, and of a looſe ſtony ſubſtance. This is the common appearance of the ſtone, and ſometimes the coats are more numerous. It is very hard, the ſubſtance being flinty, and capable of the higheſt poliſh. It is not common; but has been found in Northamptonſhire, and near Paddington.

The PEBBLE, with white, fleſh-colour, and bright red coats, and a bluiſh white nucleus, is of a fine cloſe even texture, with a very rugged wrinkled ſurface, and a roundiſh ſhape. It is not above two inches in diameter, and the nucleus is ſurrounded with many white, fleſh-coloured, and red cruſts, beautifully diſpoſed, but not always alternately; though that next it is generally red, and they all together have a very fine effect. This ſtone is generally very bright and tranſparent, and when broken has a ſmooth gloſſy ſurface; it is very hard, and will bear a fine poliſh. It is very common on Hampſtead Heath.

The PEBBLE, with brown, yellow, and fleſh-coloured coats, and a greyiſh blue nucleus, is of an exceeding fine ſmooth texture, with a ſurface a little wrinkled, and is of a roundiſh or oblong ſhape, but a little flatted, and ſeldom more than three inches in diameter. The nucleus is very beautiful, bright and tranſparent. It is encompaſſed with many coats of a pale brown, and a fine red, which ſometimes is of a fleſh colour, and alſo of a ſomewhat dark yellow. It is often debaſed with ſmall coarſe ſpots, and perhaps more than any other. When broken, it is of a fine gloſſy ſurface, is extremely hard, and capable of a very fine poliſh.

The PEBBLE, with white, yellow, fleſh-coloured, and red coats, and a greeniſh blue nucleus, is undoubtedly the moſt beautiful of the Engliſh Pebbles, for it comes up to the German Agates. The texture is exceeding fine, ſmooth, and hard, with a ſurface leſs wrinkled than moſt other kinds. The ſhape is roundiſh or oblong, and from three to four inches in diameter. The nucleus is pretty large, and ſometimes round, but more commonly oval. It is of a very fine texture, with a gloſſy ſurface, and in thin pieces quite tranſparent. It is generally of a deep bluiſh green, which is ſometimes ſo dark as to appear almoſt black, and often of a duſky blue: it is likewiſe ſometimes of ſo bright a green, that it is not inferior to the green jaſper. The coats are fine, and beautifully diſpoſed like the zones of an onyx, and are all bright and tranſparent. Some are of a bright white, others of a fine deep yellow, others of an agreeable pale fleſh colour, and others again of a bright deep red. The coats are very thin, and lie evenly throughout the whole ſubſtance of the ſtone; but the fleſh colour and white are moſt commonly near the nucleus, and the yellow towards the ſurface: however, like moſt others, it is ſubject to great varieties. It is more tranſparent than any other Pebble, and when broken is of a fine even flinty ſurface, capable of bearing the moſt perfect poliſh. It is common in many parts of England, in particular near London in the road to Highgate, and formerly was in great plenty among the gravel in the foot-path from Pancras to Kentiſh-Town. It is ſometimes uſed by our lapidaries, but not ſo much as it deſerves.

The PEBBLE, with whitiſh, brown, and yellowiſh coats, and a fleſh coloured nucleus, is of a fine and ſmooth texture, with a very firm, rough, unequal, thick cruſt, it being full of prominences and cavities. The ſhape is very irregular and uncertain, it being ragged and uneven in ſeveral parts, and looking more like a flint than a pebble. The ſize is from an inch to eight in diameter, and the nucleus is pretty large, with a ſhape like that of the ſtone itſelf. It is of an agreeable fleſh colour, with a ſlight tinge of blue, and the coats are not above three or four in number, which are of a fine deep brown, a duſky white, and a pale and darkiſh yellow. The yellow coat lies next the nucleus, the white next to that, and then the brown; and in ſome a thick yellow coat lies over theſe, bounded by a very narrow one of deep brown. The ſurface is of a pale whitiſh brown, and extremely coarſe, being often half an inch thick. It is pretty tranſparent, when broken has a fine flinty ſurface, and is ſo hard as to bear a very good poliſh. It may be met with in Yorkſhire.

The PEBBLE, with white and brown coats, and a white nucleus, is of a very fine cloſe texture, with a rugged unequal ſurface, having prominences like warts, with ſmall irregular cavities and deep wrinkles. It is commonly of a roundiſh, oblong, flattiſh ſhape, and from two to three inches in diameter. The nucleus is bright and white, but not very clear; and the number of coats is uncertain, being ſometimes three or four, and at other times ſix or eight; which are all of two colours, a fine deep brown, and a very bright white. The brown parts are very bright and gloſſy, and pretty tranſparent; but the white is much

much more opaque. When broken it is bright and ſmooth, and being extremely hard will bear a pretty fine poliſh. It is very common in the gravel-pits of Northamptonſhire and Leiceſterſhire.

The PEBBLE, with black, white, and fleſh-coloured coats, and a red nucleus, is of an exceeding fine-cloſe texture, with a ſmooth even ſurface, the wrinkles being very ſuperficial. The ſhape is generally roundiſh, and ſeldom exceeds three inches in diameter. The nucleus is encompaſſed with many thin coats of a fine jet black, a clear white, and a fleſh-colour. The black is commonly next to the nucleus, then the fleſh-colour, and after that the white; but it is ſometimes one, and ſometimes the other: the reſt follow alternately, though not always. The outermoſt coat is generally of a fleſh-colour, and over that is the cruſt, which is very thin. The nucleus is of a fine bright tranſparent red, and equal to many of the beſt cornelians. The fleſh-coloured parts are the moſt opaque of any in the ſtone; but the black coats are extremely beautiful, being very bright and gloſſy, and when thin are pretty tranſparent. When broken the ſurface appears to be flinty, it being extremely hard, and capable of an excellent poliſh. I is not very common; but it has been found on Hampſtead Heath, and in the gravel-pits of Northamptonſhire.

The PEBBLE, with yellow and greeniſh white coats, and a yellow nucleus, is of a very fine cloſe texture, with a remarkable ſmooth ſurface, it having only a few ſuperficial wrinkles. It is generally pretty round, and between one and three inches in diameter. The nucleus is ſmall, but of a fine texture, a gloſſy ſurface, and pretty tranſparent. It is of the colour of the common yellow cornelian, and encompaſſed generally with but a ſmall number of coats of two colours, namely, a yellow a little deeper than the nucleus, and a very pleaſant whitiſh green, of which colour the coat next the nucleus always is, and after that is a yellow, next a green, and ſo on alternately. The outer coat, on which the thin cruſt is laid, is ſometimes of a pale brownish white, but not always; beſides which there are often other varieties. The nucleus and the yellow coats are tranſparent, and much more ſo than the green. It is extremely hard, capable of a fine poliſh, and readily ſtrikes fire with ſteel, like the reſt of this kind. It is very uncommon, but has been ſeen on the ſhores of Yorkſhire.

The PEBBLE, with purple and pale yellow coats, and a red nucleus, is of a fine firm texture; but the ſurface is remarkably rough, being full of inequalities, though it has but a few deep wrinkles. The ſhape is irregular, and the ſize various, ſome being leſs than an inch, and others four inches in diameter. The nucleus is alſo irregular, and of a ſtrong deep red, though pretty bright and gloſſy, but with little tranſparency. It is ſurrounded by two or three coats of a fine pale yellow, and a purpliſh black colour; which laſt, held up to the light, appear of a fine deep purple. All parts of the ſtone are bright and gloſſy, but thoſe that are yellow are moſt tranſparent, and there is generally a yellow coat next the nucleus: thoſe that follow are commonly placed alternately, and are pretty thick; there is likewiſe a yellow one next the outward cruſt, which is white within, and yellowiſh on the ſurface. This ſtone is always exceeding hard, and when cut into plates is very tranſparent. It is very uncommon; but ſome have been found on the ſhores of Suſſex, and in the gravel-pits about Oxford.

The PEBBLE, with grey and pale red coats, and a yellow nucleus, is pretty fine and firm, with a ſmooth even ſurface, only there are ſuperficial wrinkles. It is generally roundiſh, and from one to ſix inches in diameter. The nucleus is of a duſky yellow, and commonly about the ſize of a hazle nut. It is opaque, has a curdled look, and is ſurrounded by ſeveral coats of a pale red, placed alternately with ſome that are thicker, of a pale aſh-colour or bluiſh grey, not unlike ſome of the paler flints. The pale red or fleſh-colour is made ſo by a mixture of grey, and the outermoſt coat is uſually of this laſt colour, over which there is a pale bluiſh grey cruſt. This is coarſe in compariſon with one of the former, though it is pretty hard, and takes a tolerable poliſh. It is found in great plenty on the ſhores of Yorkſhire, and ſometimes in the gravel-pits about London.

The PEBBLE, with red, purple, bluiſh, and brown coats, and a pale grey nucleus, is not of ſo fine a texture as any of the reſt, though it is pretty ſmooth, and very firm, with a ſurface furrowed with deep wrinkles. It is commonly of a roundiſh ſhape, and about four inches in diameter. The nucleus is of a pale grey, or whitiſh aſh colour, encompaſſed with a great number of thin coats of ſeveral colours, as a deep red, a bright purple, a greyiſh blue, and a gloſſy brown; theſe laſt are more tranſparent than any of the reſt: but theſe, upon the account of their coarſeneſs, have but a dull look, which renders the ſtone leſs beautiful. The coat next the ſtone is of a red colour, and thickiſh, but not clear or bright; next this is one of brown, but the reſt of the coats are diſpoſed without any regularity, though they are very prettily variegated. The outer coat is generally of a bluiſh grey, and thicker than the reſt; but the cruſt is commonly very thin and whitiſh. It has a ſmooth flinty ſurface when broken, and is ſo hard as to take an even poliſh. It is not common, though it has been ſometimes met with in Hertfordſhire.

The PEBBLE, with black and white coats, and a black nucleus, is of an exceeding fine cloſe texture, with a rough ſurface, generally full of deep wrinkles and protuberances, of the ſize of a horſe-bean. It is of a flattiſh round ſhape, and commonly four or five inches in diameter; the nucleus is pretty large, and of a fine gloſſy black. The coats are of a pearl colour, and black like the nucleus, and placed alternately; but the whiteſt are the thinneſt, and the outermoſt is always black, and thinner than the reſt. The cruſt that covers the whole is generally very thick, and ſeems to be of a coarſe chalky ſubſtance. It is more tranſparent than any of the former, it being extremely hard, and when broken has a fine gloſſy ſurface. It will bear a very good poliſh, and like the reſt ſtrikes fire with ſteel, but will not ferment with aqua fortis any more than they. It is pretty common on the Suſſex and Yorkſhire ſhores. It is ſometimes made into ſeals and other toys, and looks like an oriental ſtone.

The PEBBLE, with brown and greyiſh black coats, and a yellowiſh brown nucleus, has a pretty fine firm texture, though the ſurface is rough and unequal, and deeply wrinkled. It is commonly of a flattiſh round ſhape, and from two to ſix inches in diameter. The nucleus is large, and of a browniſh yellow, or tawny, ſurrounded with a few thick coats, ſome of which are of a greyiſh black, and others of a pretty clear brown. The nucleus is generally ſurrounded with a pale grey coat, after which the brown and darker grey are placed alternately. The outermoſt coat is always brown, though but thin, and the cruſt that covers it is thin and bluiſh, but of a much paler colour on the protuberances, than on the other parts. It is not very tranſparent, but has a gloſſy ſurface when broken, and is ſo very hard as to be capable of a good poliſh. It is to be met with in the gravel-pits of Hertfordſhire, Buckinghamſhire, and Northamptonſhire.

The PEBBLE, with white and greeniſh coats, and a pale grey nucleus, is of a pretty fine texture, and very firm, with a ſmooth ſurface, without many wrinkles.

wrinkles. It is almoſt always round, and is from one to three inches in diameter. The nucleus is ſmall and round, and encompaſſed with coats of two colours, ſome of which are entirely white, and others of a faint greyiſh green; but a white coat is generally next the nucleus. Sometimes theſe colours are blended with each other, and have undulated edges running through one another, to the ſucceeding coat; the outermoſt coat is of a paler or greyer green than the reſt, and but thin, as well as the cruſt that lies over it, which is of a pale bluiſh aſh colour. It is but little tranſparent, though it breaks with an even ſurface; however, it is ſo hard as to bear a pretty good poliſh. It is found on the ſhores of the river Thames, and ſometimes in the gravel-pits about Iſlington.

The PEBBLE, with yellowiſh brown and black cruſts, with a browniſh white nucleus, is the Egyptian Pebble of the lapidaries. It has an exceeding fine cloſe texture, and the ſurface is not ſo wrinkled as many of our Pebbles. It is commonly of an oblong ſhape, though ſometimes very irregular; it is of various ſizes, but the moſt common ſeems to be about four or five inches long. The nucleus is of a very irregular ſhape, and of different ſizes, but is always of a pale whitiſh brown, and ſometimes with veins or ſpots of a duſky colour. It is alſo often variegated with the colours of black trees, ſhrubs and moſſes. When it is large, it ſpreads itſelf ſo much as to have ſome reſemblance to a beaſt or fiſh, or at leaſt ſome of their parts; likewiſe ſome have had the diſtinct repreſentation of a human face. The nucleus is commonly ſurrounded with a pretty thick cruſt, of a pale browniſh yellow, and that by one of black; theſe are encompaſſed with others which are many in number, partly black, and partly of a deeper or paler yellow. Every part is much of the ſame degree of purity; but, if any, the black is finer than the reſt. It is met with in Egypt, Arabia, and ſome of the iſlands of the Archipelago. There is a ſpecies of this kind in Germany, and ſome parts of Suſſex, but they are not ſo fine as the Egyptian.

The PEBBLE, with yellow and pale brown coats, and a deep green nucleus, is very beautifully variegated, but is not ſo pure as ſome of the former, and is of a pretty coarſe, rough, unequal texture, though it is tolerably firm, and has a ſmooth ſurface, with very few wrinkles. It is generally roundiſh, and from one to five inches in diameter. The nucleus is large, and of a dark duſky green, ſurrounded by a number of cruſts in different ſtones, which are alſo different in their thickneſſes. Some are of a deep yellow, and others of a pale whitiſh brown, diſpoſed alternately; but one that is whitiſh, or very pale, uſually ſurrounds the nucleus, and the outer coat is commonly yellow, and pretty thick; the cruſt is always whitiſh, and has a chalky look, but not very thick. The ſurface when broken is not very ſmooth, and yet is ſo hard as to bear a good poliſh. It has been found on Hampſtead Heath, and about Kenſington.

CHAP. XXXIII.

Of SANDS and GRITS.

FINE Shining White SAND is generally made uſe of to dry up the wetneſs of the ink in writing, leſt it ſhould blot, and for this reaſon is almoſt univerſally known. It is pretty fine, and is generally found very pure, and of a pretty fine white. It has ſome brightneſs, and, if it be very good, is a little ſparkling, and the particles ſeem to be much of a ſize. It feels a little rough between the fingers, and ſettles very quick when mixed with water; but viewed through a microſcope the particles appear to be of very different ſizes and ſhapes, though they are all ſomewhat angular. They are all white, and though ſome are opaque, many are as tranſparent as cryſtal glaſs. It makes no fermentation with aqua fortis, nor yet any of the reſt, and therefore this circumſtance needs not be repeated. It is found in many parts of England, in ſtrata of great depth; but as there are ſome of yellow ſand lying near it, it is no great wonder it ſhould be ſometimes mixed therewith. It is of great uſe in making glaſs, but not ſo good as that with flint; however, it does not require ſo laborious a proceſs. Sands in general will ſerve for the ſame purpoſe, and they are made uſe of in ſome counties to manure ſtiff clay lands; for though they are barren of themſelves, the lands are rendered fertile by their mixture, becauſe they are thereby made more ſuſceptible of water, which otherwiſe would not penetrate ſtiff clay. This likewiſe is the principal part which beſtows firmneſs to bricks, tiles and ſtone. It is alſo of great uſe in making mortar, which commonly unites the joints of bricks and ſtones, and renders them immoveable. Likewiſe Sand mixed with mud or clay will make a ſort of mortar, but leſs durable, though often uſed in the country for the walls of cottages. It is alſo Sand that gives a conſiſtence to potters clay; for otherwiſe it would crack when wrought into veſſels, and conſequently fall in pieces, or at leaſt the veſſels would be uſeleſs. It ſometimes ſerves for poliſhing the hardeſt bodies, and for cleaning thoſe that are tarniſhed.

The Large Shining White SAND is coarſe, with reſpect to the former, though it is generally very pure. It is of a pretty good white, with ſome brightneſs and ſparkling, and ſeems to conſiſt of regular uniform particles, which are harſh and rough to the touch. When mixed with water it ſettles immediately, leaving no foulneſs behind it. All the particles are of a ſomewhat oblong and irregularly angular ſhape, and when viewed through a microſcope, the ſurfaces appear to be ſmooth, and as tranſparent as white glaſs. It is of great value among thoſe that make glaſs, and is commonly brought out of Kent to London.

Fine White very Shining SAND is the beſt of all of that colour, it being perfectly pure, pretty heavy, and of a pure white, and is very remarkable for its luſtre. It is compoſed of very uniform particles with even ſurfaces, and is extremely hard. When thrown into water it ſinks immediately, without leaving foulneſs behind it. When viewed through a microſcope, the particles appear to be a little oblong, and of irregular angular ſhape, with a fine clear water, it being little inferior to the pureſt cryſtal; and indeed this and the two former are entirely of that ſubſtance, except, as ſome ſuppoſe, there is a ſmall mixture of white earth. It is found on the ſhores of moſt of the rivers in Italy, and is of great value in glaſs-making.

Fine browniſh white dull SAND is pretty heavy, but does not ſhine to the naked eye, for it appears rather like a heap of fine duſt. The particles ſeem to be very regular and uniform, with regard to their ſize and ſhape; however, when it is mixed with water it does not ſubſide with ſuch ſpeed as the former, and leaves a whitiſh muddineſs behind it. When viewed by a microſcope, the particles appear to be of different ſhapes and ſizes, but chiefly roundiſh, ſome of them having rough ſurfaces, and others flattiſh; but they are all more or leſs tranſparent. It is found in Suſſex and Kent, but is not made uſe of for glaſs, becauſe better ſorts are plenty.

Yellowiſh White Fine Dull SAND is pure, and pretty heavy; but has no brightneſs. The particles are very ſmall, and ſeemingly very uniform and regular:

regular; to the touch it ſeems to be ſofter and finer than moſt other ſands, and yet mixed with water it ſoon ſubſides to the bottom, but leaves a yellowiſh muddineſs behind it. When viewed through a microſcope, the particles appear to be of irregular ſhapes, though they have ſomewhat of a roundneſs, and the ſurfaces of many are rough; they are tranſparent in different degrees, and the colour is not quite the ſame in all, for ſome are almoſt without any. It is met with in all parts of the world.

Reddiſh White very Fine Dull SAND, is pretty heavy, and of a whitiſh colour, tinged with a little fleſh-colour. It has not the leaſt brightneſs, and the particles ſeem to be all of a ſize, though they are exceeding ſmall, and feel harſh to the touch. Shaken together with water, it ſubſides very ſlowly, but when thoroughly ſettled it leaves no muddineſs behind; however, when viewed through a microſcope, the particles appear to be of different ſhapes and ſizes, ſome of them being at leaſt twenty times ſmaller than the reſt. They are all more or leſs tranſparent, and ſome of them are perfectly ſo. There are ſome of this ſort in England, particularly in Suſſex.

Large Browniſh White Shining SAND contains a mixture of coloured particles, and is coarſe, heavy, and of a colour which ſeem to be made up of a mixture of browniſh, yellowiſh and whitiſh, with a faint reddiſhneſs. It is very bright, and its particles, though of different colours, ſeem to be much of a ſize to the naked eye. When ſhook with water it immediately ſettles, without leaving any foulneſs. When viewed through a microſcope, the particles ſtill appear to be much of a ſize, and of an oblong ſhape with angular edges; but there are ſome that are roundiſh, and of a fine clear yellow; ſome duſky, but very beautiful, and ſome of a pale fleſh-colour. The white particles are perfectly tranſparent, but the reddiſh are almoſt opaque. It is found at Hedgerly near Windſor, where it lies among loam.

Large Yellowiſh White Shining SAND conſiſts of pretty large coarſe particles, which are very heavy, though ſomewhat leſs than the former. It is very clean, and remarkably bright and ſhining, and feels very harſh between the fingers; when mixed with water it ſubſides immediately, without leaving any muddineſs. When the particles are viewed through a microſcope, they appear to be of all ſhapes and figures, though in general they have a tendency to roundneſs; but they are much of the ſame ſize. They are generally tranſparent, and are chiefly white, mixed with ſome of a pale yellow or lemon colour. It is found all over England, and particularly near Deptford, Highgate and Hampſtead.

Large, Coarſe, Shining, Variegated SAND, is a very common ſort, and is a beautiful Sand, though not pure. It differs in its coarſeneſs and fineneſs, and in the different ſhapes of the particles. It is pretty heavy, and of a tranſparent white colour, variegated with black, red and brown, and of a chalky white, as alſo with different ſhades of yellow. The white particles, which are much the moſt numerous, have a conſiderable brightneſs, and feels very hard, though not ſo rough as ſome others. When viewed through a microſcope, it appears to be mixed with ſmall pebbles, that are opaque and of different colours, beſides fragments of larger pebbles and flints, with many pieces of the white opaque cruſts of flints. It is ſometimes found in ſtrata by itſelf, and at other times mixed with gravel. That on the ſea ſhore is always clean and bright, and mixed with fragments of ſhells; in this laſt caſe it will ferment with aqua fortis, which is owing to the ſhells mixed therewith.

Fine, Dull, Browniſh, White SAND, with heterogeneous particles, is of a dead diſagreeable colour; but is pretty fine, though not ſo heavy as many other Sands. There is little or no brightneſs, excepting a very few white glittering particles, which are here and there interſperſed, and which are certainly of a different nature from the other particles. The principal part ſeem to be pretty uniform with regard to their ſize, and the whole does not appear ſo harſh as other Sands; when ſhook together in water it ſubſides but ſlowly, and leaves a browniſh foulneſs behind it. The ſhining particles, when examined by a microſcope, appear to be fragments of talc, for they will not ferment with aqua fortis. It is common almoſt every where, and is mixed with lime and hair to make mortar for plaſtering walls and cielings.

Fine, Dull, Greeniſh White SAND, with heterogeneous particles, is pretty fine, though it has a dirty look, and the heterogeneous particles are not many. It is very heavy, is of a deep browniſh white, with a ſort of a greeniſh caſt, and does not at all glitter except where the heterogeneous particles lie, which are certainly of a talcky nature. The other particles are not all of the ſame ſize, and the whole feels hard and harſh between the fingers; when mixed with and ſhook up with water it ſettles but ſlowly, and leaves a whitiſh brown muddineſs. When examined by a microſcope, it appears to conſiſt of particles of all ſhapes and ſizes, but moſtly with ſmooth ſurfaces, and of a different colour. They are generally tranſparent and of a gloſſy white; but there are many of a ſort of greeniſh brown, and not ſo tranſparent. It is common near Deptford, Black Heath and Woolwich. This is pretty much uſed for the making of green glaſs.

Fine Glittering Greyiſh White SAND, with heterogeneous particles, owes its brightneſs to the great quantity of talc it contains; for the ſandy particles are ſmall and fine, and ſeem to have little or no tranſparency. It is pretty heavy, and the particles are irregular in their ſizes, but all of them ſmall. The talc alſo is of different ſizes, but larger than the ſand, though at the ſame time very thin. It feels hard and harſh between the fingers, and when it has been mixed with water and ſhook up, it ſubſides in a ſhort time, and leaves the water clear. When examined by a microſcope, the particles ſeem to be of three different kinds; for beſides the talc, there are ſome that have a gloſſy appearance, and a few that conſiſt of an opaque ſpar; for which reaſon it will ferment a little with aqua fortis. It is found on the ſhores of the iſlands of Scilly.

Large Shining Red SAND conſiſts of coarſe heavy particles, and is of a ſtrong red, approaching to a deep orange colour. It is not quite ſo bright as ſome of the white ſands, but the particles which compoſe it ſeem to be pretty much of the ſame ſize, though of various ſhapes, with a tendency to roundneſs. It feels extremely hard and harſh, and when mixed with water ſubſides immediately, leaving it clear. It is a foreign ſand.

Large Shining Fleſh-coloured SAND is pretty coarſe, very heavy, and is of a bright agreeable pale red, or rather of a fleſh-colour. It is remarkably bright and ſparkling, and the particles appear to be pretty much of the ſame ſize, though not all exactly of the ſame colour. It feels very harſh and rough, and when mixed with water ſubſides immediately, leaving no foulneſs behind. When examined with a microſcope, ſome have gloſſy ſurfaces, others are quite tranſparent, and others again entirely opaque; many are ſemi-tranſparent; and, with regard to the colours, ſome are white, others yellow, and others of a pale red. It is common near Naples.

Coarſe Shining Browniſh SAND, with a reddiſh caſt, conſiſts of large but pure particles which are very heavy, and ſeemingly roundiſh. It is remarkably bright and ſparkling, and the particles are of very different ſizes. It is no wonder it is very rough to the touch, nor that it ſubſides immediately in water.

water. It is common on the heaths of Suſſex and Buckinghamſhire.

Fine, Bright, Shining, Browniſh Red SAND, is very heavy, and the brown colour is more predominant than the red. The particles ſeem to be nearly of the ſame ſize and ſhape, and it feels harſh to the touch; when mixed with water it ſinks pretty ſoon, and leaves a whitiſh muddineſs behind it. It is met with in many parts of England, and particularly on Hampſtead Heath.

Very Fine, Pale, Shining, Browniſh Red SAND, is not of an agreeable colour, but is pure, though not ſo heavy as many other Sands. It is pretty hard to the touch, and ſubſides but ſlowly in water, leaving a reddiſh brown muddineſs behind it. It is common on the heaths of Suſſex.

Very Fine Pale Red SAND, with heterogeneous particles, is heavy, and of a very pleaſant colour, which conſiſts of a mixture of white, pale brown, and pale red. It glitters pretty much, and is compoſed of ſmall uniform particles, with a ſlight mixture of talc. It is harſh to the touch, and when mixed with water ſettles but ſlowly. When examined by a microſcope, the particles appear to be roundiſh and quite tranſparent. In the fire it loſes all its redneſs, which is a circumſtance not very common.

The Fine Paliſh Brown Yellow SAND makes but a dull appearance, though it is pure, fine, and pretty heavy. The colour ſeems to be made up of white, pale brown, and pale yellow, which are all very dull. The particles are of different ſizes, and ſo ſmall that they ſeem ſoft to the touch, and ſettle very ſlowly in water, leaving a whitiſh muddineſs. When examined with a microſcope, ſome of the particles appear to be perfectly tranſparent, and others almoſt opaque. It is very common all over the kingdom.

The Fine Shining Pale Yellow SAND, is pretty heavy, and of a fine colour, made up of white, yellow, and reddiſh brown. It is bright and ſhining, and the particles ſeem to be tolerably uniform. It is rough to the touch, and ſettles but ſlowly in water, leaving a yellowiſh muddineſs behind it. When examined by a microſcope, the particles are found to have different degrees of tranſparency, and thoſe that are angular are as clear as cryſtal. It found about Hampſtead and Highgate.

The very Fine, Shining, Pale Yellow SAND, is conſiderably heavy, and there is no mixture of any other colours with the yellow. It is alſo very clean, with uniform particles, which ſhine pretty much. It is harſh to the touch, and when mixed with water quickly ſubſides, and leaves it clear. It is found in Kent and Suſſex, and other parts of England.

The Fine, Shining, Gold-coloured SAND, is very pure, and heavy, and is of a fine bright yellow reſembling the colour of gold. It glitters pretty much, and ſeems to conſiſt of uniform particles. It is harſh to the touch, and ſettles immediately in water, leaving it clear. It is common on Hampſtead Heath, and in moſt other parts of the kingdom.

The very Coarſe, Shining, Pale Yellow SAND, conſiſts of very large heavy particles, and is generally pure, with an uniform colour. It glitters very much, but the particles are irregular with regard to their ſize. It is very rough to the touch, and ſubſides in water immediately. This is commonly called Scouring Sand, and is uſed by ſtone-cutters in cutting their hard ſtones: it alſo ſerves to poliſh thoſe that are deſigned for the more curious ſorts of pavements. It is common in moſt parts of the kingdom, and particularly may be met with at Hampſtead and Highgate.

The very Coarſe, Dull, Whitiſh Yellow SAND, is generally found among gravel, and is remarkable for its coarſeneſs. It ſeems to have no brightneſs, unleſs viewed very nearly, and its particles are of very different ſizes. It is common about London, and in moſt other parts of the kingdom.

The Large Shining Yellow SAND, is alſo common among gravel, and is quite pure, though coarſe and heavy. It ſhines pretty much, and the particles are tolerably regular with regard to ſize. It is extremely coarſe to the touch, and when mixed with water ſettles immediately, leaving it clear. When viewed through a microſcope, it ſeems to conſiſt of particles like ſmall pebbles, with pretty ſmooth ſurfaces. It is common about London and other places.

The very Coarſe Bright Yellow SAND, is always found at conſiderable depths, and is perfectly pure, though remarkably coarſe and rough. The particles are heavy and regular in their ſize, and perhaps it feels the roughеſt of all Sands; when mixed with water, it ſettles immediately, leaving it clear. Viewed through a microſcope, it appears to conſiſt of large cryſtalline particles of an amber colour, and of the ſhape of pebbles. It is found in Northamptonſhire, and other places, under the ſtrata of gravel.

The Large Dull Yellow SAND, is of a diſagreeable colour, though generally pure. It is conſiderably coarſe, very heavy, and of a little deeper yellow than the former, but is very far from being ſo bright. The particles are of a very irregular ſize, and though conſiderably hard they do not ſeem ſo harſh as any of the former. When mixed with water they quickly ſubſide, leaving a little yellow muddineſs. When viewed by a microſcope, the particles ſeem to reſemble pebbles; but many of their ſurfaces are very unequal and ſomewhat flattiſh, and others crooked. It is a commom Sand, and is found not only in pits, but on the ſhores of the Engliſh rivers. It is uſed by the plumbers in London as a bed whereon to caſt their ſheet lead, and is generally brought from Hackney river. It is alſo uſed by ſtone-cutters, in ſawing their marble.

The Fine Dull Deep Yellow SAND, is pretty fine, though the particles are of different ſizes. It is lighter than moſt other Sands, and the deep yellow colour is entirely without brightneſs. It is ſoft to the touch, and when mixed with water ſubſides very ſlowly, leaving a yellow muddineſs behind it. When viewed through a microſcope, the particles ſeem to be of the ſhape of common pebbles, with very irregular ſurfaces; they are pretty tranſparent, and of an amber colour. Some of the particles are ſo ſmall, that they appear like duſt ſticking to the ſurfaces of the reſt. It is common in Wiltſhire, and is found in other parts of England.

The Very Large Dull Saffron-coloured SAND, is very pure, hard, coarſe, pretty heavy, and of a deep ſtrong bright yellow. The particles are not all of the ſame ſize; it is hard and rough to the touch, and when mixed with water ſubſides immediately, leaving it clear. It is found on the Gold Coaſt of Guinea in Africa.

The Coarſe, Shining, Dirty, Yellow SAND, is very pure, large, heavy, and of a deep duſky yellow. The particles glitter pretty much, and ſeem to be regular and uniform, with regard to their ſize. It is harſh and rough to the touch, and when mixed with water quickly ſettles, leaving it clear. When viewed by a microſcope, the particles appear in the ſhape of pebbles, and are pretty tranſparent, though of different degrees of yellow. It is common on Hampſtead Heath, and many other parts of the kingdom.

The Very Coarſe Browniſh Yellow SAND, is very large, harſh, and conſiderably heavy; the colour is of a deep, duſky, browniſh yellow, but very bright and ſparkling. The particles, with regard to ſize and ſhape, are very regular, and exceeding harſh to the touch; when mixed with water it ſoon ſubſides,

and

and leaves a browniſh yellow muddineſs. When viewed through a microſcope, the particles appear to be uniform, and in the ſhape of pebbles, with very uneven ſurfaces, but pretty bright and tranſparent. It is common among the gravel in many parts of England.

The Fine Greeniſh Yellow Pale Dull SAND is of a faint ſtraw colour, with a mixture of green particles, which are generally the largeſt. The ſizes are very irregular, and it is ſoft to the touch; when mixed with water, it ſubſides ſlowly, and leaves a white muddineſs therein. When viewed through a microſcope, the particles appear to be different in ſhape, ſize and colour, and the greateſt part have uneven ſurfaces. Some are of the colour of ſulphur, others without any colour at all, both of which are very tranſparent; but the largeſt are in ſhape like common pebbles, without much tranſparency, and of a deep duſky green. It is found on Hampſtead Heath, and many other places.

The Fine Greeniſh Red Pale Dull SAND, in many reſpects, reſembles the former; but it is conſiderably lighter than moſt others, and of a pale yellowiſh fleſh colour, with a mixture of green ſpecks. The particles are of different ſizes and ſhapes, thoſe that are green being conſiderably larger than the reſt, and it is hard and rough to the touch. When mixed with water it ſubſides but ſlowly, and leaves a yellowiſh brown muddineſs therein. It is common in Suſſex.

The Very Coarſe Shining Blackiſh Yellow SAND is large, conſiderably heavy, and of a deep yellow, but mixed with black particles. It is very bright and ſhining for one of this kind, and the particles are nearly of the ſame ſize, only thoſe that are black are a litter ſmaller than the reſt. It is remarkably rough, and harſh to the touch, and when mixed with water ſettles immediately, leaving it extremely clear. When viewed by a microſcope, the particles appear in the ſhape of common pebbles, and are very bright and tranſparent, except the black, which are almoſt opaque. It is common in ſand-pits.

The Fine, Shining, Blackiſh, Straw-coloured SAND, is neither large nor heavy, and the ſtraw-coloured particles are mixed with thoſe that are black. It is very bright and ſhining, conſidering the ſmallneſs of its particles; but theſe are of different ſizes, and thoſe that are black are ſomewhat larger than moſt of the reſt. It is hard to the touch, but not very rough, and when thrown into water ſubſides very ſoon, leaving a little browniſh muddineſs therein. When viewed through a microſcope, the particles appear to be of an oblong, blunt, angular ſhape, and are all very tranſparent and bright; and even the black particles, which are not very numerous, have ſome degree of tranſparency; but they are of a roundiſh ſhape, with ſmooth ſurfaces. It is common in Suſſex, and may be met with in many other places.

The Shining, Coarſe, Blackiſh, Sulphur-coloured SAND, is hard, heavy, and of a fine brimſtone colour, with a conſiderable mixture of black. The particles are bright and ſhining, but irregular with regard to ſize, and are very harſh and rough to the touch; being mixed with water, it ſubſides immediately, leaving it clear. When viewed with a microſcope, the particles appear to be in the ſhape of pebbles, but are very tranſparent, and the black ſeems to be nothing elſe but fragments of dark coloured flints. It is common in the ſand-pits on Hampſtead Heath.

The Shining Fine SAND, of a ruſty yellow colour, is very heavy, and of a deep duſky yellowiſh brown, with a mixture of white particles, and others that have no colour at all. The brightneſs is owing to the laſt mentioned particles, for thoſe that are yellow and brown are entirely dull. They are all very irregular, with regard to their ſize and ſhape, and are very harſh to the touch: being mixed with water, they ſubſide very ſoon, and leave a muddineſs therein, as if mixed with ochre. When viewed through a microſcope, they all appear to be ſomewhat angular, and the greateſt part are of the colour of ruſty iron, and entirely opaque.

The Fineſt Brown Yellow SAND, with heterogeneous particles, is light, and of a pale browniſh yellow, with ſmall ſpangles of talc, which are not very numerous; is ſharp and harſh to the touch, and when mixed with water ſubſides ſlowly, but leaves it clear. When viewed with a microſcope, the particles appear to be roundiſh, with unequal ſurfaces nearly of the ſame ſize, and very bright and tranſparent. The ſpangles appear to be thin flakes of fine talc, having the appearance of ſilver. It is common in the ſand-pits on Hampſtead Heath.

The Very Fine Yellowiſh Fleſh-coloured SAND is very heavy, and the colour ſeems to be made up of a pale yellow, and a very pale red: when mixed with a great number of ſmall glittering particles, thoſe that are ſandy have alſo ſome brightneſs, and are pretty uniform with regard to ſize; when mixed with water, it ſubſides very ſlowly, leaving a yellowiſh muddineſs therein. When viewed with a microſcope, the particles appear to be pretty much of the ſame ſize and ſhape, but of different degrees of tranſparency; ſome are reddiſh, others yellowiſh, and ſome tranſparent; they are of the ſhape of common pebbles, and the yellow much more bright and tranſparent than the red. The ſpangles are exceeding ſmall, and appear to be thin flakes of talc. It is common in America, and is to be met with in ſome parts of England.

The Coarſe Straw-coloured SAND, with heterogeneous particles, is very heavy, and of a pleaſant pale yellow, with a conſiderable brightneſs, and pretty large white ſpangles. It looks very clear, and conſiſts of regular particles, with regard to the ſize. It is ſharp to the touch, and, when mixed with water, it ſubſides immediately, leaving it clear. When viewed through a microſcope, the particles appear to be roundiſh, very bright and tranſparent, and the ſpangles are pretty large thick flakes of talc. It is common in the ſand-pits about London.

The Coarſe Sulphur-coloured SAND, with heterogeneous particles, is pretty heavy, and of a fine pale colour, ſomewhat between ſulphur and ſaffron; it abounds with a great number of flat glittering ſpangles, which are broader than the other particles. It is harſh and rough to the touch, and when mixed with water ſubſides immediately, leaving it clear. When viewed through a microſcope, the particles appear to be irregular in their ſize and ſhape, and many of them are not very tranſparent, though moſt of them are very bright. The ſhape is like that of common pebbles, and the ſpangles appear to be fine thin flakes of talc. It is common in Italy, and may be met with in Suſſex.

The very Coarſe, extremely Shining Yellow SAND, with heterogeneous particles, is very heavy, and of a fine yellow, though a little deeper than the ordinary pale gold colour. It glitters very much, and has alſo a great number of glittering ſpangles. The particles are regular and uniform, with regard to ſize, and it is rough to the touch; being ſhook in water it ſubſides in a moment, and yet leaves a little yellow muddineſs therein. When viewed through a microſcope, the particles appear to be very like ſmall pebbles, and are all pretty tranſparent. The ſpangles are pretty numerous, but more white and leſs tranſparent than in many other of theſe Sands, becauſe they are more thick. It may be met with on Hampſtead Heath, and in many other parts of the kingdom.

The Fine Duſky Yellow SAND, with heterogeneous particles, is not heavy, and ſomewhat of a browniſh yellow. It has a very dull look; but is mixed with glittering ſpangles, and the particles are very irregular with regard to their ſize; however, the ſpangles are very few, upon which account it has a more dead look than many others. It is ſoft to the touch, and ſubſides but ſlowly in water, leaving a yellow foulneſs therein. When viewed through a microſcope, the particles appear to be of various ſizes, with unequal ſurfaces, reſembling ſmall pebbles. The ſpangles conſiſt of very thin talc. It is common in the ſand-pits about London, as well as in many other places, and is generally mixed with ochreous clay, unleſs when found on the ſhores of rivers.

The Large SAND, of a yellow gold colour, with heterogeneous particles, is hard, coarſe, and pretty heavy, and of a deep yellow colour, between ſaffron and gold. The particles are pretty bright and ſhining, but irregular, with regard to their ſize, and the white ſpangles which are large and bright are but few. It is harſh and rough to the touch, and ſubſides immediately in water, leaving a little yellow foulneſs therein. When viewed through a microſcope, the particles appear in the ſhape of pebbles, are very tranſparent, and of a fine yellow: the ſpangles conſiſt of flat fragments of ſelenites. It has been met with in Northamptonſhire, Kent, and Suſſex.

The very Coarſe Saffron-coloured SAND, with heterogeneous particles, is pretty heavy, and of a fine ſtrong ſaffron colour, or rather of a deep reddiſh yellow. The particles themſelves are without brightneſs, but it is full of glittering ſpangles of talc. The particles are very irregular with regard to ſize, and they are pretty harſh to the touch; when mixed with water, they ſettle very ſlowly, leaving a yellow foulneſs therein. It is common in Germany, and has been found in Suſſex and Leiceſterſhire.

The very Fine Duſky Saffron-coloured SAND, with heterogeneous particles, is not heavy; the colour is a duſky browniſh yellow, with ſomewhat of a brightneſs; but the numerous ſpangles of talc make it appear greatly ſo. The particles are pretty regular, with regard to ſize, and the ſpangles are but little broader than they. It is harſh to the touch, ſettles ſlowly in water, and leaves a browniſh muddineſs therein. When viewed through a microſcope, the particles appear to be ſmall, and in the ſhape of pebbles, but not very tranſparent; the ſpangles appear to be thin flakes of talc. It is common in the ſand-pits about Highgate and Hampſtead, and in other parts of the kingdom.

The very Fine Brown Dull SAND conſiſts of fine particles, which are not very heavy nor bright, inſomuch that they appear like a heap of duſt; however, they are pretty regular and uniform, with regard to ſize, and are harſh to the touch; in water it ſubſides but ſlowly, and leaves a muddineſs therein. Through a microſcope, the particles reſemble ſmall pebbles with uneqnal ſurfaces, and are pretty tranſparent, but not bright. It is met with in the ſand-pits about Woolwich and Blackheath.

The very Coarſe Shining Pale Brown SAND is one of the coarſeſt that is met with in this kingdom, though it is not remarkably heavy. The particles are pretty bright and ſparkling, and regular with regard to ſize. It is very coarſe and harſh to the touch, and mixed with water ſubſides immediately, leaving it clear. It is common about Woolwich.

The very Coarſe Shining Duſky Purple SAND is very large and heavy, and of a deep purpliſh brown or chocolate colour, interſperſed with white. The brightneſs is in a great meaſure owing to the white particles, and it is very rough to the touch; when mixed with water it ſubſides almoſt immediately, leaving a ſomewhat yellow muddineſs therein; through a microſcope, the particles appear to be much of the ſame ſize and ſhape, being roundiſh. They are of two different colours, namely, chocolate colour, and white, which laſt are always ſmooth, and the former rough. It is to be met with near the Hot-Well at Briſtol.

The Dull Brown Coarſe SAND, with heterogeneous particles, is pretty heavy and of a pale brown, but very dull. The particles are irregular with regard to ſize and colour, ſome being much browner and coarſer than the reſt. When mixed with water, it ſubſides immediately, leaving it clear. When viewed through a microſcope, the particles appear of different ſhapes and ſizes, but chiefly like pebbles, and pretty bright and tranſparent. There are flattiſh fragments among them, which ſeem to be a ſort of flint of different ſhapes, and there are others which are fragments of ſpar, upon which account it will ferment with aqua fortis. It is met with near Oxford.

The very Coarſe Shining Pale Brown SAND, with heterogeneous particles, is large, pretty heavy, and of a faint pale brown colour; the particles are bright and pretty uniform, with regard to ſize. It is harſh to the touch, and mixed with water ſubſides immediately, leaving it clear. When viewed through a microſcope, the particles appear to be of different ſhapes and colours, ſome being opaque and bluiſh, others tranſparent and inclining to yellow; but the greateſt number are in the ſhape of pebbles with ſmooth ſurfaces, and of different degrees of a pale brown. Alſo there are many fragments of white brown tranſparent ſpar, upon which account it will ferment a little with aqua fortis.

Small Shining Greyiſh Black SAND is perfectly pure, and conſiderably fine and heavy; the colour is of a bright greyiſh black, and has a very agreeable look, the particles being uniform, both with regard to ſhape and ſize, and of a conſiderable brightneſs. It is harſh to the touch, and when mixed with water ſettles but ſlowly, though it does not leave the leaſt foulneſs therein. When viewed through a microſcope, it ſeems to be very bright and quite tranſparent, the particles appearing to be of an obtuſely angular figure, and without any manner of colour. It is brought from Italy, where it is common.

The Fine very Shining Reddiſh Black SAND is clean, heavy and variegated with pale red, fleſh-colour and white. The brightneſs is inherent in the particles it conſiſts of, which are nearly of the ſame ſize, though different in ſhape, thoſe that are black appearing roundiſh, and the others flat. It is ſharp and harſh to the touch, and when mixed with water ſettles immediately, leaving it very clear. Viewed through a microſcope, the particles appear like different gems; thoſe that are black are almoſt opaque, with ſmooth ſurfaces and pretty round, but the others are all very bright and quite tranſparent, ſome being roundiſh and others flat. It has been hitherto found only in America, on the ſides of hills and the ſhores of rivers.

The Coarſe Duſky Green SAND, variegated with white, is pretty heavy, and of a deep dull green, with a conſiderable number of white particles. They are all nearly of the ſame ſize, but of different ſhapes. It is commonly harſh to the touch, and when mixed with water ſettles immediately, leaving it entirely clear. Viewed through a microſcope, the white particles appear to be of two ſorts, ſome of which are half tranſparent and cloudy, with obtuſe angles, and others have ſharper ridges, but are bright and quite without colour, beſides which there are a few tinged with a faint yellow. The green particles, which are moſt numerous, are of a deep yellowiſh green,

and of various ſhapes. It is brought from Virginia, where it is common.

The Fine Snow-white Stony GRIT is a perfectly pure and homogeneous ſubſtance, and ſmall in proportion to its weight. Its particles are very bright and ſparkling, and very regular in the ſize. It is harſh to the touch, ſubſides immediately in water, and leaves it quite clear. It ferments violently with aqua fortis; for which reaſon it ſeems to be compoſed of a very fine ſpar. It has been found in Mendip Hills in Somerſetſhire, in the perpendicular fiſſures of the ſtrata of ſtone.

The Dull, Coarſe, White, Stony GRIT, is much inferior to the former; for though it is perfectly pure, it is very hard and coarſe. The colour is dull, there being little or no brightneſs; but the particles are very regular, with regard to their ſize. It is harſh to the touch, and in water ſubſides immediately, leaving it of a ſort of milky colour. This alſo ferments briſkly with aqua fortis, and therefore muſt conſiſt of ſpar. It is met with in the ſame places as the former.

The Fine Cream-coloured Stony GRIT is pale, very heavy, and of a yellowiſh white or cream colour. It is very bright and ſparkling, and conſiſts of particles that are irregular with regard to ſize. It is harſh to the touch, and in water ſubſides immediately, leaving it a little milky. Viewed through a microſcope, the particles appear to be of different ſhapes and ſizes. They are all pretty tranſparent and bright, and ſeem to be without any colour. It conſiſts of ſpar, for it will ferment violently with aqua fortis. It is found in one of the iſlands of the Archipelago.

The very Coarſe Bright White Stony GRIT is very impure, and conſiſts of two ſorts of particles. It is very heavy, and of a duſky white colour, which however glitters in ſome places. The particles are all large, but very different in ſize, ſhape and colour. It is hard and harſh to the touch, and in water leaves a little milky foulneſs. Viewed through a microſcope, it appears to be compoſed of a confuſed mixture of cryſtalline and ſparry particles. It ferments ſtrongly with aqua fortis, and a thin ſtratum of it has been found near Loughborough in Leiceſterſhire.

The Very Coarſe, White, Stony GRIT, with heterogeneous particles, is conſiderably heavy, and of a pure white, with black, yellow, and white flakes of talc. It is harſh and gritty to the touch, and ſubſides immediately in water, leaving a little whiteneſs therein. When viewed through a microſcope, it appears to conſiſt of large irregular particles, pretty tranſparent, and very white. The particles of talc have all very gloſſy ſurfaces, though of different kinds; but will not ferment with aqua fortis. It is common in Wales on the ſea ſhore under cliffs.

The Dull, White, Fine, Stony GRIT is heavy, and of a dull whitiſh colour, with particles that appear to be much of the ſame ſize. It is rough to the touch, ſubſides quickly in water, and leaves a foulneſs therein. Viewed through a microſcope, it appears to conſiſt of opaque particles with rough ſurfaces, and of no certain ſhape. Among theſe there are a few looſe ſpecks, with ſurfaces as bright as cryſtal. It ferments violently with aqua fortis, and is entirely white when burnt. It is common in Derbyſhire, and other places, where there are ſtrata of ſtone.

The Dull, White, Coarſe, Stony GRIT, is hard, pretty heavy, and void of brightneſs, and the particles are of different ſizes and ſhapes. It is hard to the touch, and when mixed with water ſubſides immediately, leaving a muddineſs therein. Viewed through a microſcope, the particles appear to have rough ſurfaces, and are quite opaque; but there are a few very ſmall ſhining cryſtalline ſpecks. It ferments very ſtrongly with aqua fortis, and when burnt is entirely white. It is common in Yorkſhire, and ſome other counties, where there are very large ſtrata of it.

The Browniſh, White, Fine, Stony GRIT reſembles the former, is not very heavy, and void of all manner of brightneſs. The particles differ both in ſhape and ſize, and are not very rough or hard to the touch. When mixed with water, it leaves a muddineſs therein after the ſubſidence. When viewed through a microſcope, the particles ſeem to be of a looſe ſpongy texture, and opaque, only there are a few ſhining ſpecks in ſome parts. It is met with in the great ſtone quarry near Bath in the cavities of the ſtone, and ferments briſkly with aqua fortis. It is alſo common in Lieceſterſhire.

Glittering, Greyiſh, White, Fine, Stony GRIT, with heterogeneous particles, is pretty heavy, and of a pleaſant pale greyiſh white. The particles are mixed with fine ſhining white ſpangles, and are different with regard to ſize, without the leaſt brightneſs. The glittering proceeds from a mixture of a conſiderable quantity of talc. It is hard and rough to the touch, and when mixed with water ſubſides but ſlowly, leaving a whitiſh muddineſs therein. When viewed through a microſcope, the particles appear to be different, both with regard to ſize and ſhape, and beſides the talc there are a few cryſtalline ſpecks. It ferments violently with aqua fortis, and is common in the hills of Yorkſhire.

Greeniſh, White, Stony GRIT, with heterogeneous particles, is pretty fine, very heavy, and of a duſky greeniſh white colour. The particles are different, both with regard to ſize and ſhape, without any brightneſs; but there is a mixture of broad flat particles of talc, which makes it glitter very much; it is not very rough to the touch, and when mixed with water ſubſides but ſlowly, leaving a greeniſh muddineſs therein. When viewed through a microſcope, it appears to conſiſt of ſtony particles, which are different both with regard to their ſhape and ſize; but they are pretty tranſparent and bright, and the white talc appears in flakes. When burnt, it is of a pale browniſh colour, and is met with in ſome parts of this kingdom.

The Coarſe, Greeniſh, Grey, Dull, Stony GRIT, with a few heterogeneous particles, is very large, harſh, pretty heavy, and of a dull greeniſh grey colour, intermixed with a very few talky ſpangles, which are much leſs than the ſtony particles, that are alike both with regard to their ſize and ſhape. It feels pretty harſh and rough, and ſubſides immediately in water, leaving it quite clear. When viewed through a microſcope, the whitiſh coarſe particles, though not bright, are a little tranſparent, and there is here and there a cryſtalline ſpeck, beſides the particles of talc. It burns to a pale duſky red, and is common in Yorkſhire and other places.

The GRIT, called the Puteolan powder by the antients, is a ſort of greyiſh powder, compoſed of particles which are ſo exceeding ſmall, that, when viewed through the beſt microſcopes, no diſtinction appears among them. It looks perfectly dull of itſelf, for what brightneſs there is may be probably owing to the talky particles. When mixed with water, it ſubſides very ſlowly, leaving a great whitiſh muddineſs therein. When mixed with ſalt water, it ſoon dries into a hard ſtony maſs, which will not afterwards eaſily diſſolve when mixed with common water. It was uſed by the antients as a mixture for their cements of buildings near the ſea. It is now known by the name of the Pozzolane, and is an ingredient of hard plaſters, in ſeveral parts of France and Italy.

Fine Pale Reddiſh Stony GRIT is heavy, and of a very

very pale whitiſh or browniſh red; it is very bright and ſparkling, and even to a greater degree than many of the ſands. It is harſh and rough to the touch, and mixed with water ſubſides immediately, leaving it entirely clear. The particles, when viewed through a microſcope, appear to be of irregular ſhapes, ſome of which are of a pale red, others browniſh, and others without any colour at all. It ferments ſlightly with aqua fortis, and undergoes little change in the fire. It has been found near Briſtol.

The Pale Red, Shining, Coarſe, Stony GRIT, is pretty heavy, with particles that are irregular, with regard to their ſize, and remarkably bright. It is very harſh to the touch, and immediately ſubſides in water, leaving it extremely clear. When viewed through a microſcope, the particles appear to be cryſtalline and quite tranſparent, but of irregular ſhapes; ſome of them are without colour, and others are of a very pale red. It will not ferment with aqua fortis, nor will the fire produce any great change. It is found on the coaſt of Fife, in Scotland.

The Greyiſh Red, Coarſe, Shining, Stony GRIT, is very heavy, and the particles are of various ſhapes and ſizes, many of which are very bright and ſhining, and others quite opaque. It is very harſh and hard to the touch, and immediately ſubſides in water, leaving it very clear. When viewed through a microſcope, ſome of the particles appear to be white, and very opaque; others are without colour and tranſparent, and others again are ſtained with a pale red. It ferments ſtrongly with aqua fortis, and burns to a fine red. It is found on the ſhores of the iſland of Minorca.

The very Coarſe Greeniſh Red Dull GRIT is very heavy, and of a fine fleſh colour, variegated with green. The particles are pretty uniform and regular, with regard to their ſize, and they are of an irregular angular ſhape. It is very hard to the touch, and ſubſides immediately in water, leaving it clear. Through a microſcope, ſome of the particles appear to be whitiſh, others of a pale red, and others of a fine light green; but they are all pretty tranſparent. It is found on the ſhores of the Mediterranean ſea.

The Fine Shining GRIT, of the colour of ruſty iron, but darker, is full of ſpangles that appear bright and glittering, which are not talc but cryſtalline, and without any colour. They are much of the ſame ſize, and extremely harſh to the touch; they ſubſide very ſoon in water, leaving it extremely clear. Through a microſcope, the particles appear to be of different colours; for ſome are whitiſh, others yellowiſh and ſemi-tranſparent, and others without any colour, and as bright as cryſtal; but the greateſt number are brown. It is found near Liſbon in Portugal.

Fine Red Stony GRIT, with heterogeneous particles, is very heavy, and of an agreeable red colour, with a whitiſh caſt. The ſtoney particles are a little bright, but the mixture of glittering flat ſpangles renders the maſs extremely ſo. All the particles ſeem to be uniform with regard to their ſize, and are very rough to the touch; in water they ſubſide immediately, leaving it quite clear. Through a microſcope, the particles of this grit appear to be tranſparent cryſtal, of a pale red, and all ſomewhat angular, interſperſed with very bright tranſparent particles of browniſh white talc. It is found on the ſhores of the iſland of Minorca.

The Coarſe Red Variegated GRIT, with heterogeneous particles, is very bright and heavy, though light and coarſe; the colour is variegated, though the red predominates, and the particles of that part are very bright and ſparkling; beſides theſe, there are many white cryſtalline fragments, and a vaſt variety of yellow and black flakes of talc, all which glitter very much, and give the whole a pretty pleaſing appearance. They are all nearly of the ſame ſize, feel extremely harſh and rough, and in water ſubſide immediately, leaving it clear. It is found on the coaſt of Scotland.

The very Coarſe, extremely Shining, Fleſh-coloured, Variegated GRIT, with heterogeneous particles, is more beautiful than the former, and pretty heavy. The fleſh colour or pale red is very lively, and variegated with black and brown particles of talc, beſides ſome that are white and cryſtalline; and all the particles in general are very bright and glittering, but irregular with regard to their ſize. It is hard and harſh to the touch, and ſubſides immediately in water, leaving it clear. When viewed through a microſcope, the particles all appear to be large and coarſe, but of very different ſhapes and colours, though ſome are reddiſh and yellowiſh, others without colour, and others again, that are blackiſh and reddiſh, or opaque. The talky ſpangles are brown and black, for there are none that are white.

The Fine Browniſh Red Variegated GRIT, with heterogeneous particles, is not ſo glittering as the former; but it is very fine, heavy, and of a faint browniſh red, variegated with white, black and yellow. The particles are all bright and ſhining, and much of the ſame ſize. It is ſharp to the touch, and in water ſubſides but ſlowly; however, it leaves it clear. The particles, when viewed through a microſcope, appear to be of irregular ſhapes, ſome of which ſeem to be ſpar, are ſemi-tranſparent, and whitiſh, reddiſh, or browniſh; others are cryſtalline without colour, though ſome are reddiſh or browniſh and very bright, and others opaque and ſtony, and of a blackiſh or reddiſh colour. Thoſe with the talky flakes make a very agreeable appearance, for they are of different colours, as white, yellow, and black. It ferments a little with aqua fortis, but undergoes no change in the fire.

The Fine Fleſh-coloured Variegated GRIT, with heterogeneous particles, is not ſo beautiful as any of the former, though it is very fine, pretty heavy, of a bright fleſh-colour, and very glittering. The particles are all nearly of the ſame ſize, and there is little variegation of white and black. It is ſharp to the touch, and ſubſides immediately in water, leaving it clear. When viewed through a microſcope, the particles appear to be of very irregular ſhapes, and ſome are white, others reddiſh, and others without any colour at all. They are not all equally tranſparent, but the greateſt part of them are very bright, and there is a mixture of flaky ſpangles of talc, of white, brown, and black colours, with a few blackiſh ſtony particles. It burns to a paler colour.

The extremely Pale, Whitiſh Red, Variegated GRIT, with heterogeneous particles, is not ſo finely coloured as ſome of the former; but it is extremely fine, very heavy, and of a pale whitiſh fleſh-colour. It is variegated with many black ſpangles, the particles are all very bright and glittering, and are nearly of the ſame ſize. The talky ſpangles are black, and remarkably thin. It is ſharp to the touch; and, though it ſubſides ſlowly in water, it leaves it very clear. When viewed through a microſcope, all the particles appear to be tranſparent, except a few that are black, and the fire turns it to a grey colour. This and the four former are common on the ſhores of iſlands in the northern parts of the world.

The Browniſh Red Coarſe Stony GRIT, with heterogeneous particles, is conſiderably heavy, and of a fine pale fleſh-colour, variegated with brown, and there are a few glittering plates of white talc. The particles are regular with regard to their ſize, and pretty bright and ſhining, which render the whole

whole maſs very glittering. It is ſharp and harſh to the touch, and ſubſides immediately in water, leaving a little muddineſs therein. Through a microſcope, the particles appear of different ſhapes; but moſt of them are flattiſh and bright, though not very tranſparent. Some are of different degrees of fleſh-colour, others of no colour at all, and there are alſo brown particles, that are more tranſparent than the reſt. There are a few ſpangles of white talc, which are very thin, and ſmaller than the other particles. It burns to a little pale red. It is met with on the ſhores of the Red Sea.

The very Coarſe Shining Blackiſh Fleſh-coloured GRIT, with heterogeneous particles, is remarkably heavy, and of a mixed colour, between pale red and black, and the particles are bright and ſhining, beſides which there are a few black flakes of talc, but not ſo large as the other particles, though they are of different ſizes. They are very hard to the touch, and ſubſide immediately in water, leaving it clear. Through a microſcope, the particles appear of various colours, ſhapes and ſizes; for ſome are white, others of a pale red, and a great number are black, and though they are not tranſparent, they ſhine more than the reſt. It does not undergo any change in the fire. It is found on the ſhores of the iſlands of Sicily.

The very Coarſe Shining Reddiſh Green Stony GRIT, with heterogeneous particles, is conſiderably heavy, and a reddiſh green, or rather of a greeniſh red. The particles are partly green and partly red, intermixed with many that are white, and all together are bright and ſparkling: there are alſo a few ſpangles of greeniſh white talc. All the particles are nearly of the ſame ſize, and are very hard and ſharp to the touch; they ſubſide immediately in water, leaving a reddiſh muddineſs therein. It is found on the ſhores of the Mediterranean ſea.

The CRYSOCOLLA of the ancients is a beautiful green, though dull Grit; it is ſomewhat coarſe, moderately heavy, and of an exceeding lively and agreeable green, with very uniform particles, which are nearly of the ſame ſize, but of little brightneſs. It is not very harſh to the touch, and ſubſides immediately in water, leaving it quite clear. Through a microſcope the particles appear to be pure, and in angular figures, generally approaching to a rhomboidal form. It ferments ſtrongly with aqua fortis, and tinges it with a bluiſh green. It is found on the ſhores of New England, and is taken to be green ſand; it has alſo been brought from the ſhores of the Red Sea. It is uſed by goldſmiths for the ſoldering gold, and by painters as a colour. That is looked upon to be the beſt, which comes neareſt the colour of an emerald.

The Fine Shining Pale Green GRIT is very heavy, and variegated with white; it is very bright and ſhining, the particles are regular in their ſize, and it is harſh and ſharp to the touch; it ſubſides immediately in water, leaving it entirely clear. It is found upon the ſhores of the Red Sea.

The Shining Gold-coloured GRIT, with heterogeneous particles, is light in compariſon of many others. The flakes are of different ſizes, and it is ſofter to the touch than any other kind; it ſubſides ſlowly in water, and leaves a whitiſh yellow muddineſs therein. Through a microſcope, the ſtony particles appear to be reddiſh, whitiſh, and ſeemingly tranſparent. It is found in Virginia, Germany, France, and England.

The very Hard Fine Black GRIT, variegated with white, is the hardeſt, heavieſt, and brighteſt of all the Grits, and is of a fine jet black colour, with a few ſpecks of white. It conſiſts of particles nearly of the ſame ſize, and is exceeding hard to the touch; it ſubſides immediately in water, and leaves it entirely clear. Through a microſcope, the particles appear to be all angular, of which ſome are whitiſh, and others greyiſh, but both are very tranſparent; yet thoſe of a jet black, which are moſt numerous, are entirely opaque. It is met with in France.

The Fine Black and White GRIT, with heterogeneous particles, is pretty heavy, and the principal particles are bright and ſhining, but they are rendered more ſo by the mixture of fine white flakes of talc; it is harſh and ſharp to the touch, and ſubſides very ſoon in water, leaving it quite clear. Through a microſcope, the black particles appear to be opaque, and there are a great many tranſparent, without any colour, and exceeding bright; the flakes of talc are alſo tranſparent. It is brought from the ſhores of the Mediterranean ſea.

The very Coarſe Black and White GRIT, with heterogeneous particles, is extremely heavy, and its particles ſeem to be all nearly of the ſame ſize; the greateſt part ſeem to be coarſe and dull, but there are a few that are bright; however, the quantity of talc makes it glitter pretty much; for they are white and gloſſy. It is rough to the touch, and ſubſides immediately in water, leaving it very clear. Through a microſcope, it ſeems to conſiſt of a great number of white ſemi-tranſparent particles, of which there are ſome as clear as cryſtal, and very bright, beſides many of coarſe white talc, and a great many others that are black and opaque. When burnt it is of a fleſh colour, with black and white ſpots. It is found in Wales.

The Shining GRIT, of a ruſty black colour, with heterogeneous particles, is conſiderably fine and heavy, but entirely dull of itſelf, though the great number of black flat ſhining particles make it ſhine very much. It is harſh and rough to the touch, and ſettles immediately in water, leaving it entirely clear. Through a microſcope, it appears to conſiſt of different particles; and thoſe without colour, as well as the yellowiſh and reddiſh, are like ſmall pebbles; theſe are bright and pretty tranſparent, beſides which there are many others of uncertain ſhapes, and quite opaque: theſe ſeem to be fragments of ſtones of different kinds; and there are a great many that are duſky, with ſomewhat of a reddiſh colour, ſuppoſed to be pieces of iron ore. Beſides theſe, there are multitudes of ſpangles of different ſhapes and ſizes, which are all very bright, and are taken for fragments of lead ore. In the fire it becomes blacker, and is known in England by the name of black writing ſand.

The Coarſe Sparkling Browniſh Black GRIT is much like the former, but is more coarſe, and remarkably heavy. It owes its ſparkling to flat ſhining particles like the former, though they are not ſo many in number. It is very ſharp to the touch, and ſubſides in water immediately, leaving a little blackneſs therein. Through a microſcope, the particles appear to be various, of different ſhapes and figures, but nearly of the ſame ſize. They are partly fragments of ſtone, and partly iron and lead ores; but they are not ſo bright as in the former, they having ſmaller ſurfaces. The iron ore is diſcovered in this by means of a loadſtone, as well as in the former. It is common on the ſhores of Wales, and ſerves for the ſame purpoſe as the preceding.

The Fine Browniſh Black Sparkling GRIT is pretty fine, and remarkably heavy, with an agreeable bluiſh black bright colour. The particles are of various ſhapes and ſizes, and it is pretty harſh to the touch; it ſubſides immediately in water, and leaves it quite clear. Through a microſcope, the particles appear to be of various colours; for ſome are reddiſh, ſome greeniſh, and others blackiſh, mixed among a vaſt number of particles of various ſizes and ſhapes, but all of a bluiſh black, with gloſſy ſurfaces. It ferments ſlightly with aqua fortis, which is probably owing to the ſparry matter

ter contained therein. It is common on the ſhores of Wales.

CHAP. XXXIV.

Of MARCHASITES and PYRITES, or FIRE STONES.

THE generality of Authors think Marchaſites and Pyrites to be the ſame ſubſtance, and others diſtinguiſh them, making two different ſpecies thereof. Boet obſerves, there are ſeveral kinds of Pyrites, and that all ſtones, that ſtrike fire properly, deſerve that name. Some are bright like ſilver, others conſiſt of ſeveral coats, others are like dice. Some are like red marble, and ſhine with a metalline ſplendour, others are purple, quadrangular and tranſparent, and others again are ſpongy and ſhining or pumiceous. Some have eight angles, others have twelve, others are like biſmuth, and others again are tinged with a gold colour, from whence they take the name of Marchaſites. Some are of a copper-colour; others are of various colours and forms, and others are mixed with ſtones. Among theſe, ſome will melt in the fire, and are added to metals inſtead of lead, to render them more fuſible, and when they are broken they ſhine like ſugar-candy. He adds to this, that there are ſtones called Pyrites, which will not ſtrike fire with ſteel, and theſe he thinks ought not to be placed in that claſs. Among the Marchaſites ſo called by ſome there are,

The Silver-coloured MARCHASITE, which is of a very firm and compact texture, and remarkably heavy. It is found making ſtrata of itſelf, which though very broad are thin, being from three inches to a foot in thickneſs. Sometimes there are pieces found by themſelves, and in general they have a very irregular and unequal ſurface, they being made up of great numbers of irregular flakes, and of various ſizes; they being bent, undulated, and ſometimes infold each other. However, theſe plates are not at all diſtinguiſhable by the naked eye, but ſeem to conſtitute one ſolid maſs. The colour reſembles that of ſilver, but is more glittering. It readily ſtrikes fire with ſteel, but will not ferment with aqua fortis; and when put into the fire it cracks and breaks, emitting a blue flame with the ſmell of brimſtone. After it has burnt a conſiderable time, it turns to a deep red. Sometimes this Marchaſite is mixed with lead ore, ſometimes with that of tin, and very often a duſky brown ferruginous ſubſtance. It is found in great plenty in lead and tin mines.

The gold-coloured MARCHASITE is more glittering than the former, but not ſo compact, though pretty heavy. It is commonly found in thin ſtrata, and ſometimes in pieces. It ſeems to be compoſed of flat flakes, not unlike great numbers of irregular fragments of leaf gold, placed together without the leaſt order. However, ſome parts of this Marchaſite are more looſe and open than others, though it is all in its natural ſhape of a deep yellow gold-colour; however, it is ſometimes paler, ſometimes deeper, and at other times will reflect all the colours of the rainbow. It will not ſtrike fire with ſteel ſo readily as the former, nor will it ferment with aqua fortis. When thrown into the fire, it will ſlowly emit a blue flame from all parts of its ſurface. It is plenty in Germany, particularly in Hartz foreſt, and has been met with in England, but not ſo often as in the former.

Heavy white MARCHASITE is very firm and ſolid, and more heavy than the other two. It is often found in ſtrata by itſelf, and ſometimes in detached pieces; but is more commonly met with in the cavities of other ſtrata, of the breadth of ſeveral yards. It has a ſmoother ſurface than the others, and is more uniform in its compoſition; though, if it be carefully examined, it ſeems to conſiſt of undulated flakes laid cloſely upon each other. It ſtrikes fire with ſteel; it will not ferment with aqua fortis, and when put into the fire burns pretty briſkly, emitting a blue flame, with the ſmell of brimſtone. It is found in Devonſhire, Cornwal, and ſome other counties. Theſe are all the Marchaſites properly ſo called, taken notice of by authors.

The Flat Pyrites or FIRE-STONE, with a rough coat, can hardly be diſtinguiſhed from other Stones by its external appearance. It is pretty firm and hard, as well as heavy, and is of no certain ſize, being found from one inch to ten in diameter. It is always flat and thin, and has very unequal and irregular edges. When it is about four inches long, it is half an inch thick, and requires a ſtrong blow to break it in pieces. When broken its texture ſeems to be regular and uniform, conſiſting of one homogeneous maſs, of a duſky browniſh green colour, ſurrounded with a coat of a duſky ferruginous ſubſtance, which is rough and beſet with ſmall pebbles of different ſhapes and ſizes, though generally no bigger than grains of ſand. It is always of the colour of ruſty iron, and is thicker in ſome than in others. It will ſtrike fire with ſteel, but not ferment with aqua fortis; and in the fire it emits a blue flame which ſoon goes out, and when ſufficiently burnt it turns to a deep purple. It is found in gravel-pits all over the kingdom.

The Round PYRITES, with a cracked coat, is coarſer than the former, it being compoſed of viſible grit. It is very heavy, and of various ſizes, from half an inch to twelve in diameter, and requires a ſtrong blow to break it. The colour is pale, with a mixture of dull whitiſh green, and a duſky browniſh cloud. The outer coat or cruſt is of a browniſh yellow, and of different thickneſs; the ſurface is divided by ſhallow cracks, and after it has been for ſome time in the air, they become deeper. It readily ſtrikes fire with ſteel, and in the fire emits a ſtrong blue flame, and laſt of all calcines to a purple powder. It is common in the chalk-pits of Kent, and many other places.

The Flat PYRITES, with a very thick whitiſh brown cruſt, is extremely hard and firm, though moderately heavy. It is commonly flat and round, or oval, and its uſual ſize is two inches and a half in length, two in breadth, and one in depth. The ſurface is rough, it being full of ſmall tubercles, and it has the look of a lump of browniſh clay; it requires a ſmart blow to break it, and when broken, a nucleus is found of the ſame ſhape with the whole ſtone. This is very compact, firm, and hard, and of a deep duſky green. The nucleus will ſtrike fire with ſteel, and burns to a red; but the cruſt itſelf turns to a pale brick colour. It was found in a clay-pit near the end of Gray's-Inn-Lane, and very probably may be met with in many other places.

The Green PYRITES, without a cruſt, is met with in a great variety of different ſhapes. It is of a hard firm cloſe texture, and very heavy, and is found from half an inch to ten inches and upwards in length. Sometimes it is in the ſhape of a common pebble, but it is more generally flat, with an uneven undulated ſurface, and ſeems to conſiſt of many plates laid one upon another. It is extremely hard before it has been expoſed long to the air, and is, both within and without, of a pale ſilvery green. It readily ſtrikes fire with ſteel, but will not ferment with aqua fortis; it readily cracks and breaks in the fire, emitting a fine deep blue flame, and turning at laſt to a florid red. It is very common in all parts of England, particularly in ſtrata of blue clay.

The PYRITES, reſembling a bunch of grapes without

without a coat, is of a firm hard ſtructure, and remarkably heavy. It is commonly ſmall, and of a longiſh form, though ſometimes round, and many pounds in weight. It is moſt commonly without any cruſt, and requires a ſtrong blow to break it. When broken, it appears to be a kind of a metallic body. It is moſt commonly of a very pale green, though ſometimes deeper, and the ſurface is always covered with tubercles of various ſizes, ſo as to have a diſtant reſemblance of a bunch of grapes. It ſtrikes fire readily with ſteel, emits a blue flame in the fire, and ſoon falls to pieces; but at length turns to a beautiful purple. It is common in many parts of England, and when it has been long expoſed to the air, has often a thin coat of a ruſty colour.

The Round PYRITES, with a ſtreaked ſtructure, and an irregular ſurface, is very heavy, and is uſually found in a roundiſh ſhape. The general ſize is from four to ſix ounces in weight, though there are ſome of two or three pounds. The ſurface is irregular, and ſometimes beſet with flattiſh tubercles, and ſometimes raiſed in ridges, on account of their being placed in diſtinct rows, which meet in various angles. It is pretty hard, and when broken appears to be of a ſtreaked texture, and the ſtreaks run from the centre to the circumference. It is of a whitiſh green within, is covered with a brown cruſt, and is very bright and glittering when juſt broken. It ſtrikes fire with ſteel, and burns to a purple powder. It is common in chalk-pits.

The Round PYRITES, with angular tubercles, is remarkably heavy, and is found from an ounce to a pound or upwards in weight. It is generally roundiſh, and the ſurface is remarkably rough. It is of a ruſty colour, and is covered over with ſhort quadrangular pyramids, which are broad at their baſis, and blunt at their points, commonly ſtanding very upright and cloſe to each other. It cannot be broken without a ſtrong blow; but when it is in pieces, theſe are found to be ſtreaked, and of a greeniſh colour, with ſome ſmall mixture of yellow. It ſtrikes fire with ſteel, and will flame ſoon in the fire, with the ſmell of brimſtone, and burſts to pieces; after which it calcines to a fine deep purple. It is common in England in the ſtrata of chalk.

The Silver-coloured Round PYRITES, with a ſmooth ſurface, is of a pretty firm texture, and remarkably heavy. It is commonly round, and the uſual ſize is about an inch and a half in diameter; but it is ſometimes met with to the weight of two pounds. It is always without tubercles and ridges, and the ſurface is of the ſame colour as the inſide, though not quite ſo bright. It breaks with a ſmall blow, and when broken appears to be of a ſtreaked texture, of a beautiful ſilvery green colour, and the ſtreaks run from the centre to the circumference. It ſtrikes fire with ſteel, and in the fire emits a blue flame, with a ſtrong ſmell of brimſtone, after which it burſts and calcines to a deep purple powder.

The PYRITES, with a foliaceous ſurface, is of a very firm though uneven texture, but very heavy; it is of various ſhapes, but commonly round. It is of different ſizes, but generally large, though thoſe of ſix or eight inches are commonly round. It is harder than moſt other ſtones of this kind, and when broken appears to be of a ſtreaked texture, and the extremities of the ſurface are ſeen in rows of thin leafy plates, which cover the whole. They generally lean one way, but are of unequal thickneſſes, and ſometimes notched at the end. The colour is a duſky green, which when broken is very bright and glittering. In the fire it emits a deep blue flame and burſts, after which it calcines to a purple powder. It is found at Goſlear in Saxony, and in Hartz foreſt, and ſometimes in England, particularly Mendip hills, Derbyſhire, and Cornwal.

The PYRITES, with a ſmooth gloſſy ſurface, is of a very firm coarſe regular ſubſtance, and remarkably heavy. It is of a very particular ſhape, being always more or leſs hollow, and in various forms, often like pebbles, but more particularly rugged and knobby. The common ſize is five or ſix inches in diameter, and the ſurface is ſo gloſſy, that even the tubercles thereon appear to be ſo. It is very hard, and when broken appears to be ſtreaked with irregular cavities, and the ſtreaks are more narrow than in other ſtones of this kind. On the inſide they commonly terminate in broad plates, nearly of a ſquare figure, and are diſpoſed in rows. The general colour is greeniſh; but if it is broken where theſe plates are, it is commonly of a bright beautiful yellow. It emits a blue flame like the reſt, and calcines to a fine red.

The Large Foliaceous PYRITES, in the ſhape of a cube, is of ſo regular a figure, that it has by many been thought to have been the effect of art. It is of a firm regular ſtructure, very heavy, and is commonly found about one third of an inch in diameter. All ſides are perfectly ſmooth, and it breaks in all directions; for it conſiſts of plates in the direction of all the ſurface. It is gloſſy on the inſide when juſt broken, and ſeems to be compoſed of plates like talc. It is of a fine whitiſh green colour, with a ſmall mixture of yellow. In the fire it emits a deep blue flame, with a ſtrong ſmell of brimſtone, and calcines to a deep purple. It is found in Germany, Hungary, and the Eaſt Indies.

The Small Solid PYRITES, in the ſhape of a cube, is not unlike the former, it being firm and hard, and very heavy. The ſhape is regular, and the ſize is commonly about an eighth of an inch in diameter. It is perfectly ſmooth on every ſide, and when broken is very bright and gloſſy. Its colour is commonly a pale yellowiſh green, though in thoſe that are large it is ſomewhat of a ruſt colour. It cracks and burſts in the fire, emitting a deep blue flame, and at laſt calcines to a fine red. It is frequently to be met with in the northern parts of England, and many other countries. It is here found in common black ſlate, but in Germany about the earth on the mountains.

The Bright PYRITES, with eight ſides, is very firm and compact, of a pretty even texture, and very heavy. It is always compoſed of eight triangular planes, though it is ſubject to ſome varieties. Its moſt perfect ſhape is when two pyramids are placed evenly one againſt the other; but they are more commonly ſet uneven and ſlanting, and their planes are very irregular, with regard to their ſize. It is from the bigneſs of a large pin-head to that of a walnut; they are naturally ſmooth, and of the colour of poliſhed iron. When broken the pieces appear very bright and ſparkling, and often much paler than the outer ſurface. They ſeem to be compoſed of irregular thin undulated plates, laid more cloſely together than in the marchaſites. In the fire it cracks and burſts, emitting a blue flame, with the ſmell of brimſtone, and at laſt calcines to a deep purple. It is found in Cornwal, and is very common in North America.

The Hard Shining PYRITES, with twelve ſides, when perfect, is extremely beautiful, but is ſeldom met with in that ſtate. It is pretty hard, of a regular texture, and very heavy. It is ſubject to great irregularities; but often wants one or more of its ſides, and has commonly other bodies of its own ſubſtance ſticking faſt to it. It is of various ſizes, it being from one inch to four in diameter; but is more frequently about the third part of an inch. The ſurface is ſmooth and ſhining, and generally of a pale yellow, ſometimes of the colour of ruſty iron, and ſometimes of poliſhed ſteel. When broken it appears to be of a foliaceous ſubſtance, and to conſiſt

of very thin plates irregularly placed, and may often be diſtinguiſhed by the naked eye. In the fire it emits a blue flame, with the ſmell of brimſtone, and calcines to a bluiſh purple. It is found in Cornwal, but is more common in Germany, as well as in the Eaſt and Weſt Indies. It is obſervable, that all theſe kinds of ſtones ſtrike fire with ſteel, and will not ferment with aqua fortis.

CHAP. XXXV.

Of FOSSILE PETRIFIED BODIES.

BEFORE we come to particulars, it will not be improper to take notice of petrifications in general, ſome of which are performed, as it were, within our ſight, and therefore are moſt eaſy to be underſtood. The firſt of theſe is the ſtalactites, which is a kind of cylinder formed on the roofs of ſome caves and grottos, and which has been already taken notice of in its proper place. This is evidently brought to paſs by means of the water, which carries with it very fine ſand, that by length of time increaſes to different ſizes, and forms the different layers which are ſucceſſively produced one over another.

Another kind of petrification, which is well known, are the cruſts of ſtone, which the water of ſome ſprings fixes by little and little to the pipe through which it paſſes; for theſe are almoſt every where to be ſeen. From theſe it plainly appears, that the matter of the petrifications, let their nature be what they will, is driven by water to the ſides of the pipe in ſmall particles, which being applied to each other without any regularity, forces the water itſelf to turn from the centre of its courſe, to make a paſſage for itſelf; becauſe the ſtony matter is applied as it were by chance.

Another ſort of petrification, alſo very well known, is that of the pieces of wood, ſhells, and other ſubſtances, that are petrified in the bowels of the earth, or in ſprings, without loſing their ſhape, or diſtinguiſhing marks by which they are commonly known. Theſe may be diſtinguiſhed into three kinds; that made in plates or layers, that done by pellets or balls, and that by penetration.

The ſubſtances by which theſe are brought about, are water, ſalt, oily juice, ſand, mud, and clay. The water ſeldom penetrates the ſubſtance of ſtones to no purpoſe, but carries with it and mixes the materials of which it is compoſed; much in the ſame manner as the maſons make uſe of water wherewith to blend and intimately unite the materials of which they make morter or cement, that grows hard in proportion as the water flies off.

The three different petrifications are performed likewiſe by minute maſſes or lumps, and a very fine cement. The maſſes to be incorporated are the ſand, clay, and loam: the moſt durable cements are the ſalts, and ſeveral kinds of bitumen. Sometimes the ſalts, intermingled with the clay, ſerve as a cement for the ſand; at other times, the maſs is compoſed of clay, or loam alone, without any intermixture. From the different degrees of theſe ſeveral bodies, thus differently intermixed, proceed a vaſt variety of productions.

To the firſt kind of petrification we may refer talcs, ſlates, plumous alum, and plaſter. As for cryſtal, it is nothing but a heap of ſand, perhaps in a pyramidal or triangular ſhape, which the water applies ſucceſſively one upon another, uniting them together with a little ſalt, and very fine mud; this is the more probable, becauſe when cryſtal is decompoſed in the fire, there remains nothing but calcined ſand, earth, and a little ſalt. We need not wonder that cryſtal ſhould be thus formed into a tranſparent maſs, becauſe ſeveral ſorts of white ſand, viewed through a microſcope, appear to be nothing elſe but true white cryſtal. The earth or mud, that is joined thereto, only hinders them from ſhining like a diamond.

It is eaſy to imagine, that a fall of water may bring into any place a layer of ſand and blackiſh earth, and that a ſecond may throw another upon the former, and ſo on; inſomuch that, in length of time, ſlate may be produced of different thickneſſes. In the ſame manner different ſubſtances may form talc, plumous alum, and plaſter.

The ſecond ſort of petrification is that, which is performed by ſmall bullets or balls, and often by bunches compoſed thereof. It is probably by this means that gems receive their formation; becauſe many of them are found in the chinks and cavities of certain rocks, where the water can bring nothing with it but ſand, ſalts and a little bitumen, and by chance ſome metalline particles. Theſe ſmall congelations of matter, coming to ſink and harden by degrees, may carry along with them the very fine particles they meet with. The generation of irregular flints, and all other ſtones that will ſtrike fire with ſteel, ſeems to be the ſame as that of gems; for the water meeting in its courſe certain cavities more or leſs wide in marl, chalk or clay, that are in rocks, there depoſits the ſalts, the oily fluids, and the fine ſand with which it is imbuted. This water afterwards evaporating, the ſand, and every thing that is introduced within the cavity, becomes hard as in a mould, and forms a maſs which takes the ſame figure. When fine ſand is the principal ingredient, the concretion is more or leſs tranſparent and hard, as are all ſorts of gems. The colours are dull, variegated, or marbled with veins, in proportion to the different mixtures of the ſubſtance of which they are formed. When there is a great deal of ſalt or ſulphur, which are well known to contain particles that ſtrike the noſe and yield fire, then the ſtone will have a ſtrong ſmell of ſulphur when it is broken or ſtruck, and will ſparkle when it meets the blows of another ſtone as hard as itſelf, or when it is ſtruck with the ſteel or hammer, that by its extraordinary hardneſs diſcompoſes the pores wherein the particles of fire are lodged. Theſe ſorts of ſtones very evidently contain a great deal of fire, and therefore they might be ſuppoſed by ſome to be electrical, and yet it is plain they have no ſuch quality, which may be owing to the earthy particles in which the fire lies hid, and which may prevent the effects of rubbing, in the ſame manner as a lock of wool placed againſt a glaſs, or when tied to the ſtring of a muſical inſtrument, prevents the vibrations, and conſequently the ſound.

There are a great many flints and flinty ſtones that are exactly round or oval, or approaching thereto, and of all ſizes, which ſeem to be compoſed of, or form ſmall pellets or plates, by means of a nucleus which is the baſis of the whole. When the water is loaded with a ſmall bit of marl, or ſome ſmall ſtone, as it repaſſes through this ſmall maſs, it will fill up its pores or inequalities with the clay or other particles contained therein, and will beſtow upon it a ſmooth and pretty regular ſurface. If this is repeated ſeveral times by the application of the water to the maſs, it will always leave a ſmall layer or coat of ſand before it flies off. Theſe circular layers or coats growing hard, by the evaporation of the water, will form a ſmall arch, which will grow ſtill ſtronger and ſtronger, by the ſucceſſive application of ſeveral other layers or coats. The whole will grow more thick in proportion to the number of times that the water returns, and depoſits freſh matter. It may ſo happen that the nucleus of chalk, marl, ſtone, or clay, which has been as it were the foundation of the firſt arch, being rendered hot by ſome external means, all the moiſture will evaporate

and diminish the size. By these means it may often come to pass, that there may be a nucleus in the middle of the stone, as we often find by experience; which may be sometimes chalk, sometimes common earth, or other substances, quite different from that of the stone; so that at length by shaking the stone it may be easily found by the rattling, that some substance is contained therein. Thus the formation of round and oval stones becomes much the same as that of certain stones which are known by the name of Bezoars, and which are found in the bellies of several animals, both in the East and West Indies, and to which great virtues are attributed.

Some of these stones, that have a cavity in the middle, often contain a hard substance, or another stone, which may be easily known from the noise it makes when shaken; and this is commonly called by the name of the Eagle Stone, to which most extraordinary qualities have falsely been attributed.

The third manner of petrification is what is called by some penetration, and this is the most common; thus a large bed of sand, clay, or other matter, may be petrified by the salts and other particles wherewith the water is imbuted when it sinks therein. The water will carry with it all the fine salts it has dissolved and taken up by the way, as well as the exceeding fine earthy particles which have remained therein. This water will readily pass, as well as every thing it contains, through a bed of sand, that is too full of pores to stop it; but it will fill by degrees all the interstices of more compact sand, and will closely unite all the particles; and by this means we may understand the formation of what we commonly call free-stone. A bed of earth or of sand will be changed into a stone more or less hard in proportion to the quantity of clay or sand contained therein. Marl and potters clay thus mixed with sand will be changed into marble, whose ground may be either red, green, or black, according to the nature of the petrified bed. Perhaps the ground of any marble may be nothing but very fine sand, into which the water has penetrated, and carried at many thousand different times the fine particles of marl and potters clay, and which in process of time may obtain the hardness in which they are found; and consequently their natures, colours, mixtures, and clouds, may vary to infinity. If the potters clay has been dried and cracked by some subterraneous heat, the fine sand, or marl, or other substances which are carried by the water, and deposited in the chinks or cracks, may produce veins of all colours, and of all shapes. Likewise, when there are particles of gold, or any other metal, that are fine enough to be dragged along by the water, they may serve to augment the richness of these variegations. The drops of oily fluids, which the water carries along with it, may expand and form a multitude of small spots, which may be round when they are at liberty, or oval when they are a little confined on each side; or, in short, they may be angular, or of any other shape, according to the impediments they meet with. All the winding veins, on the sides of which we sometimes see rows of small specks of gold, or other metals, extremely fine, serve to shew very evidently the progress that the water has made; for when it happens to be stopped, and obliged to turn, it penetrates wherever it can, and so produces very irregular variegations. The particles which the water contains, being naturally a little more heavy than itself, must needs be deposited in time, and stopping by the way, must penetrate the very first cracks or other cavities that they meet with. We may compare the formation of a marble, or other stone, to that of cloth or tapestry; for the body of the sand or clay, which is capable of penetration by water, may be compared to that which weavers call the warp, and the water to the shuttle, which passes across the other without stopping. The fine sand, the particles of common clay, the colours of potters clay, the fine threads or small leaves of metallic substances, may all together be compared to the woof, which is introduced into the body of the work, and which fills it by little and little.

However, it sometimes happens, that there are thin plates or layers of clay between the different beds or strata of stone, and which are free from any mixture at all; from whence it appears, that they have hindered the progress of the water, for they only served to sustain, and could not be penetrated by it. Perhaps it may be thought a wonder, why there should be any stratum of stone or marble under this clay, since the water could not get through it; but this will soon cease, when we consider, that many parts of the clay may be very thin and full of cracks, and consequently will admit the water to pass very freely through it. All the water with its contents may run over the clay, and may be shed, at the extremity of this layer, into the bed which lies beneath; and it has been found by experience, that many rocks of an enormous size will not prevent the water from passing through their bowels, and falling into beds of sand that are placed underneath.

That which the water performs, by the penetration of the different strata contained in the earth, it brings about in some degree with regard to pieces of wood, bones, and other substances which it enters into; and which affords us a reason or method of explanation of all the different petrifications, though never so odd, which are to be met with in all parts of the world. We cannot determine whether there has ever been an universal earthquake or not, which has changed its primitive form; for we find several sorts of animals, and sometimes mankind, in small islands at a vast distance from the main land, which can hardly be accounted for, but from some extraordinary cause, that has produced great irregularities in the face of the earth, making that to be a sea, which was dry land before, and raising up mountains out of the bosom of the deep; especially since we find, from some such change, that there are a vast number of marine bodies at a great distance from the sea, and a great deal higher than its surface. However, this is certain, that many substances, which seem to have been proper only to the sea, are now found in the bowels of the earth; and which have perhaps been petrified by degrees, by the insinuation of water, salts, and exceeding small crystalline or stony particles, proper to fill up their pores, without alteration of their shape. To this all the productions which some have looked upon as *lusus naturæ*, or sports of nature, are evidently owing. Besides the bones of crocodiles, the skeletons of sea horses, the entire bodies of petrified fish, there are almost every where found sea shells of all kinds, and all sorts of the parts of sea animals, converted into stone. Some are very wonderful with regard to their situation, and others as to the oddness of their shapes. However, some are of opinion, that if these changes have been in reality produced by earthquakes, it will not from thence follow we should find them converted into stone; but this may be easily accounted for, if we reflect a little on what has just been said: for their situation is no more difficult to be comprehended than that of flints, which are generated in the middle of other substances; for, though they undoubtedly were in their natural state before the alterations were made, yet it is easy to conceive in what manner they have been petrified since that time. These petrifications have had different names bestowed upon them by naturalists, and therefore it will be necessary to give a more distinct account thereof.

thereof. They are principally of two kinds, that is, animal and vegetable ſubſtances; ſome of which have remained in the earth a vaſt number of years without any great alteration, and others have been covered with or turned into ſtone; however, they all come under the denomination of Foſſils.

With regard to trees, there have many been found buried under ground in many parts of the world, and particularly in England; as on the coaſt of Suffolk near Dunwich, in the fens of Lincolnſhire and Yorkſhire; and more particularly in the iſle of Axholm, which is made by rivers, and lies between Nottinghamſhire, Lincolnſhire, and Yorkſhire; as alſo on the coaſt of Pembrokeſhire in Wales. Theſe have not only been found near the ſea, but in inland countries at the depth of ten or twenty ells.

In England, there are ſome that lie at a diſtance from the ſea, as in Chatmoſs in Lancaſhire, ſeveral parts of Yorkſhire and Cheſhire, as well as in Staffordſhire. The places in this laſt county where they are found are Laynton, and the old Pewit Pool in the pariſh of Norbury; Shebben Pool, in the pariſh of High Offley; the moſſes near Eardley, in the pariſh of Audley, and near the town of Betley; all which lie in the high country of the moor lands. They are found ſtill farther from the ſea in Cranmoor near Wrotteſly; in Rotten Meadow under Wedneſbury Hall; on Dorley Common in the pariſh of Gnoſal; in a place called Peat-Moor, and in the moors of Handſworth; none of which are leſs than thirty, and ſome are above fifty miles from the ſea. Some will have theſe to have been originally formed in the earth, eſpecially becauſe they reſemble firs, of which ſort none ever grew naturally in England, if we may believe the account that Cæſar gives in his Commentaries; but his authority is not always ſufficient. However, this appears plainly to be a miſtake; becauſe many of theſe trees have their roots ſtill remaining, as well as the ſtumps of their branches. If there is any ſuch thing in reality as foſſile wood, it is generally allowed not to ſwim on the ſurface of the water; whereas all theſe before mentioned will: beſides, they ſtill retain the qualities of wood, and ſometimes they are found ſwimming in pools, which the country people get out, cleave into ſplinters, and make uſe of them inſtead of candles. The chief difficulty lies in knowing whether firs ever grew in England or not; and ſome, to ſolve this, have pretended that they have been brought hither by ſome flood, particularly that of Noah, where they have lain ever ſince. It muſt be acknowledged, that there is no impoſſibility in this, or at leaſt that they may have been brought hither by ſome ſuch means; becauſe they are full of a large quantity of bitumen, which no doubt would preſerve them from corruption a vaſt number of years. However, this account is not very probable, becauſe if they had been brought hither by a flood, they would have been found in all the low places alike, and in the ſouth of England as well as in the north; for there are none in the vales of Eveſham and Ayleſbury, nor indeed in many others, which ſeem to be moſt likely. Some of theſe trees appear as if they were burnt, and others have the marks of the ax ſtill remaining upon them; beſides, the ſtumps, from which they were cut, are in ſome places alſo remaining, and appear in the ſame poſture as when the tree was growing; particularly in Shebben Pool, when the ſummer is dry and the waters low. Others, with more probability, have thought that theſe trees were not fir, but birch or alder; becauſe they delight to grow in moiſt places, and having been ſoaked many years in a bituminous ſtuff, have been ſo well impregnated with an oily matter as to imitate fir both in ſmell and burning: however, this can hardly be the caſe, becauſe they ſplit exactly like fir, and becauſe they have evidently a turpentine ſmell; and beſides, at Axholm in Lincolnſhire, there have been found trees thirty-ſix yards long, excluſive of the tops, which lay very near the roots to which they belonged. But it would detain the reader too long, and be foreign to our preſent purpoſe, to endeavour to account for the manner in which theſe trees have been brought into this iſland.

Other trees, beſides firs, have been found to have been buried under ground; for Dr. Moreton takes notice of a ſmall maple-tree that he met with in a ſtratum of clay at a conſiderable depth; and near Bath part of an elm-tree has been diſcovered of a conſiderable length: no doubt there have been many others, which have not been thought worth notice. But beſides entire trees, or the principal parts, there have been commonly found in the fuel known in many parts of England by the name of Peat, and which is dug out of the earth, ſeveral fruits and catkins of other trees, that have been little altered in their texture. The moſt common of theſe are hazle-nuts; and near Whitleſea the twigs, as well as leaves, of white poplar have been ſeen, with the branches of hazle, and great numbers of the ſkeletons of leaves and catkins, beſides the ſtones of plumbs or ſome ſuch fruit. There have been ſome pretty large branches of trees found in the ſtrata of ſtone, and commonly more or leſs changed into the nature of the ſtrata in which they lay. A great variety of ſmaller branches have been found in the ſtrata of blue clay, which ſerves to make tiles in the neighbourhood of London; but though they were in their original ſhape, yet their internal ſtructure was much altered; for they ſeemed to be changed into the ſubſtance of the common vitriolic pyrites. Theſe, and others of the like kind, are thought to have been branches of oak, and they are generally altered in ſome ſenſe to the nature of the ſtrata in which they lie, by the inſinuation of cryſtal or ſtony particles; but in ſome the veins of the wood are ſtill preſerved, and appear very beautiful when poliſhed.

Dr. Plott takes notice of ſtones which he calls STELECHITES, whereof one in his time was met with near Dudley, called by the country people the Pox Stone, that is, a ſtone which undergoes little alteration by fire. It was ſo much like petrified wood, that he took it for the ſtump of a tree at firſt ſight. There are others of this name that are not ſo worthy of it, particularly the Stelechites of Aldrovandus, that has the appearance of antimony; whereof many are found in the rocks near Beresford and Stanſop, and among the rubble ſtones that lie looſe above ground in the fields near Heatly and Bagots-Bromley. They are a ſort of annular ſtones, regularly jointed and regularly ſtreaked at the top and bottom; and therefore as unlike the trunk of a tree, though ſome of them are branched, as any thing can well be; nor indeed do they reſemble the trunk or ſtem of any plant whatever. Mr. Ray takes them to be the petrified back or tail bones of fiſh, becauſe they generally conſiſt of ſeveral plates or pieces ſticking together, like the vertebræ of the back-bones of ſome ſorts of fiſh; though he acknowledges, that they are ſhorter and thinner than the bones of any fiſh he had then ſeen.

Beſides trees, and parts of trees, there have been different kinds of plants, which have undergone the ſame fate; and have either been wrapped in the black ſlaty ſtone found over the ſtrata of coals, or in looſe ſtones of a ferruginous ſubſtance. Some ſorts of ſtones contain the perfect images of plants, which ſeem to be nothing more than a painting, becauſe the fluid contained in the plant, has ſo intimately penetrated the ſubſtance of the ſtone, that it ſeems to be all of a piece with it, and has preſerved nothing

thing more than the figure. The plants that are thus found are of different ſorts, but the moſt common are of the fern kind, yet not ſuch as we have in England, for ſome pretend they are only to be met with in America. There are alſo a great number of ſea moſſes, with which many parts of the bottom of the ſea are covered. An ear of barley has been found in one, or at leaſt its image, very exactly painted. Some of the ſtones, when they have been ſplit, have contained the figure only of the plant, while the other ſide has appeared more prominent; which ſeems to have been occaſioned by the petrifaction of the plant itſelf. Some of the ferns thus found have been different from any ſpecies hitherto known; inſomuch that it is hard to ſay, whether or not they were precedent to the formation of the preſent globe of the earth.

Though theſe impreſſions have been moſt commonly found in the ſlaty ſtones above mentioned, yet there have been other ſtones met with in which they have been ſeen, though perhaps not ſo commonly; particularly, there is a whitiſh ſtone in Germany, not much harder than chalk, in which they have been frequently ſeen; as alſo a grey ſlate ſtone of a very fine texture, where they have been often found, beſides one of a blackiſh blue colour. Not only the entire branches of plants appear in theſe ſtones, but ſometimes the leaves of trees; particularly thoſe of the poplar, willow, white thorn, pear-trees, and many others.

Perhaps it will not be improper to take notice of others that are leſs ſingular, and which are common in Germany. Theſe are the leaves of oak and other trees which hang over ſprings whoſe waters have a petrifying quality, by whoſe means they are often covered with a cruſt like the moſſes in many parts of England. The ſtone that covers them ſeems chiefly to conſiſt of a ſort of ſpar. Many ſpecimens of all theſe kinds are frequently to be met with in the cabinets of the curious.

Dr. Plott has met with ſome ſorts of theſe petrifications in Oxfordſhire, particularly at Somerton, where the graſs is covered with a ſoft ſtone, yet in ſuch a manner that when it is broken off the graſs appears as freſh and green as before it was incruſted. Some of the blades of graſs grow at leaſt to a foot in length, and yet when pulled up with the root, and held up by that part, it might be pulled out as entire as a ſword out of the ſcabbard. At North Aſton, in a field north-weſt of the church, there is another petrifying water, where the roots of ruſhes, graſs, and moſs are in a ſhort time eaten away, inſomuch that nothing remains afterwards except the figures of thoſe plants, with ſome augmentation. In the pariſh of St. Clement's in the ſuburbs of Oxford there is a ditch, the water whereof covers with a cruſt the ſticks that fall out of a hedge. At Carfax, in the city itſelf, there is a pump, that not only covers the boards that fall into it with a cruſt, but alſo enters the very pores of the wood, which by degrees rotting away, there is nothing left at length but the linaments of the wood itſelf.

Petrifications of this kind are always very brittle; though they leave a faint repreſentation of the grain of the wood, yet they never preſerve its colour; and in the fire they are as incombuſtible as ſtone; for they change nothing but their colour, which becomes more whitiſh: however, they will entirely diſſolve in aqua fortis. There are ſome indeed that are petrified in a different manner, and will preſerve both the colour and texture of the wood: they are ſometimes ſo hard that they will cut glaſs, and will always ſtrike fire with ſteel.

The petrifications of marine ſubſtances are more common than thoſe of any other ſort; and among them are found fiſh of various kinds, more eſpecially ſhell-fiſh, or rather the ſhell of thoſe fiſh. However, it is not very common to find any which repreſent the figures of river fiſh; though there is one called the Barbel Stone.

There are other foſſils called OSTRACOMORPHOS, which conſiſt of heaps of oyſter-ſhells cemented together. There are many other petrified ſhells that are not found in cluſters, but each of them lie ſingle in a ſeparate ſtate. Of theſe ſome are curiouſly ſtreaked or furrowed, and others plain, with few or no ornaments. Of theſe again ſome are of a turbinated form, and others bivalvular, joined together by a hinge, yet the ſhells of theſe are commonly found apart. Among theſe are thoſe called the Stromboites, from their wreathing like a ſcrew, and generally from the right hand to the left, and from the greater to the ſmaller end. The largeſt exceed nine inches in length; but thoſe in England, at leaſt that have been hitherto found, are not much above five, with a plain ſurface; and the leaſt are not above half an inch long, but curiouſly ſtreaked. They are of an aſh colour, ſomewhat inclined to yellow, and of a harder conſiſtence than the ſtone in which they lie.

There are ſome petrifications that reſemble cockles, ſcollops, and oyſters; and theſe are very numerous. The CONCHITES, or cockles, may be divided into the greater and the leſs; whereof ſome of the greater are ſtreaked with broad ſtreaks and pretty deep furrows, deſcending as it were from a centre at the top, and expanding themſelves to the rim of the ſtone. They have alſo ſix or ſeven tranſverſe ſimple lines, bent circularly to the hinge or joint; theſe appear to be a ſtone without, of a dark aſh colour; but within they are found to be black flint. There are others again whoſe ſtreaks deſcend from the hinge or joint, and yet not in ſtraight lines, but undulated, and much broader than the former.

There are ſeveral kinds of the ſmaller Conchites, which differ in their colour, lines, and valves; for ſome are yellow, and are found in the fields near Burford in Oxfordſhire; their valves riſe high, and approach to a roundiſh ſhape. Theſe made red hot, and put into beer, are accounted by the country people to be an immediate remedy for a ſtitch. In another part of this country, there are ſome of this ſort that are flatter, and of an aſh colour; but in both the lines run from the joint to the rim. Theſe laſt are found only at the head of a ſpring, but never at any diſtance from it. Some of theſe have been found only ſtreaked on one ſide, and rubble-ſtone on the other; and others have but juſt begun to be marked with lines.

There are others of this kind found in a bank of yellowiſh clay, and are of a different form from thoſe juſt mentioned, for they are ſtreaked tranſverſely. Many of them appear to be hard ſtones, and yet ſeveral that have been met with were nothing but clay; which may juſtly raiſe a doubt, whether or not many of theſe, which have been generally ſuppoſed to be petrified ſhells, are properly ſo called.

There is another ſort of Conchites found in Hornton quarry, nearly approaching to an oval, and ſcarcely ſtreaked at all; which inclines Dr. Plott, as well as Dr. Liſter, to think that theſe ſtones, which are ſo like cockles, never were in reality the ſhells of that fiſh.

There is ſtill another ſort of Conchites found in Hornton quarry, which is not ſtony on the inſide like the former, but is hollow, and filled up with ſpar. It is ſometimes in irregular figures, but generally forked. The baſe, or place where the branches of the fork are united, is at the joint or hinge of the valves; which ſeems ſomewhat hard to account for.

There are alſo petrifications or ſtones, which reſembles ſcollop-ſhells, and are always found ſeparate.

One of theſe is very curious, and reſembles the Rough Scollop of Aldrovandus. It is of a yellowiſh colour, and has ears on both ſides, with lines that run from the hinge or joint to the rim of the ſhell. Theſe are very prominent; and there are others that run tranſverſely, not bending towards, but from the hinge or joint; however, theſe do not paſs through the deep furrows ſo as to join with each other, for they are only upon the ridges. There is another kind of ſcollop, where the direct and tranſverſe lines are of an equal depth, but very ſhallow, very numerous and fine. In theſe the tranſverſe lines bend towards the joint. It is of a light reddiſh colour, with ears on both ſides, and is found in the quarries of Heddington in Oxfordſhire.

There is another ſhell or ſtone like a ſmall ſcollop, of a whitiſh yellow colour: the ſtreaks are large and broad in proportion, but the tranſverſe lines are ſmall and narrow; however, it is eared, like the former, on both ſides. Theſe are called Pectunculi by Rondeletius, and he makes them a diſtinct ſpecies from the larger ſort, which he names Pectines; but then thoſe that he ſpeaks of have never more than one ear, which is ſometimes on the right, and ſometimes on the left ſide; but this has ears on both ſides. There is another of the ſmall kind intirely without ears, nor is there any ſign of the ears being broken off; however, there are real ſhells of this kind taken notice of by different authors. There is ſtill another ſort reſembling a ſcollop, or, as ſome think, a ſort of cockle, becauſe it bears too much on one ſide for the former. It cannot be a Tellenites, becauſe if it has any ſtreaks at all, they never run that way. Theſe are in great plenty in ſeveral parts of Oxfordſhire; ſome of which are large, and as it were heaped one upon another; and others ſingle, or found by themſelves. The real ſhell-fiſh that anſwers to theſe are called Streaked Cockles; but they are always very ſmooth within, whereas ſome of theſe are evidently ſtreaked on the inſide; and the ſtreaks not only run from the joint or hinge to the rim, but there are four or five broad tranſverſe ſtreaks, made up of ſeveral lines almoſt cloſe to each other; for which reaſon ſome would have it to be a ſtone of a particular kind.

Beſides the ſhells already mentioned, there are others that ſeem to be of the oyſter kind, which are very common in the gravel-pits in ſome parts of Oxfordſhire; among theſe, there is one of an oblong ſhape, which is very thick, and of a bluiſh colour, and ſeems to be the ſame as the thick oblong concha taken notice of by Dr. Merrit, which he found in Worceſterſhire, where they are called Crow-ſtones, Crow-cups, and Egg-ſtones.

There are other ſhells or ſtones that have ſome reſemblance to muſcles; but they are of an odd ſort of a figure, and there are no real ſhells that we know of like them. They are not hollow, but are filled on the inſide with a ſtony earth of a yellowiſh colour, and their covering is white and ſhining, with oblong lines. It is very long and narrow in proportion, and is marked, but very faintly, like the ſhell of a common muſcle.

There are other petrifications reſembling ſhell-fiſh, of the ſofter cruſtaceous kind, ſuch as the Sea Urchin, which for ſubſtance and hardneſs are much like a pebble, and of a yellowiſh colour. They are divided at firſt by five pretty ſtraight lines, adorned on each ſide by a double row of points, aſcending from a protuberant centre in the baſis of the ſtone to another ſhape at the top, but foliated round in the manner of a roſe. It is likewiſe ſubdivided by five other indented lines, which terminate before they reach the centre; but they make the ſpaces between them appear like pentagons, or like the ſhells of ſome kinds of tortoiſes. Aldrovandus takes notice of a ſtone of this kind, which he imagined reſembled the Sea Hedge-hog deprived of its prickly coat. Dr. Plott calls it the Porcupine Stone without briſtles. There is another that is curiouſly embroidered and reſembles the Sea Hedge-hog of Imperatus. It is of a whitiſh aſh colour without, but within is a hard black flint covered over with thin glittering plates placed edgeways on the ball of the flint, and which compoſe the uniform eminences and depreſſures with waved and tranſverſe lines. Some Writers calls theſe Serpents Eggs.

There is another ſort of Hedge-Hog Stone, which reſembles the ſhell of a kind of ſea hedge-hog, and is ſaid to be like the ſtellated eggs of that hedge-hog. Their outermoſt coat is full of ſharp prickles, upon which account they are ſometimes called Sea Cheſt-nuts, becauſe of their likeneſs to the rough prickles that encompaſs cheſtnuts while they are on the tree. When they are dead, all the prickles will fall off, and then the ſhell is diſcovered, which is curiouſly wrought, and reſembles the ſtone of which we are now ſpeaking. They conſiſt of many compartments and eminences, which are ſo regularly diſpoſed, that the moſt ingenious embroiderer cannot eaſily imitate them. It may be doubted, whether there is any animal with a ſhell like this ſtone; for no account has been given of any ſuch hitherto. There is alſo another kind of Echinites or Hedge-hog Stone found in the quarries near Shotover Hill. The inward ſhell of this fiſh is very ſmall though the prickles are long and ſtiff; and it is always found in the deepeſt waters ſticking to the rocks.

The Cornu Ammonis, or Ammon's Horn, is ſo called becauſe it is like the horns of rams, which were conſecrated in the temple of Jupiter Ammon, ſeated in the ſandy deſarts of Lybia. They were formerly taken to be petrified ſerpents, and ſeveral authors have compared them to the nautilus, or have confounded them with each other. The unpetrified Ammon's Horns are divided by ſeveral partitions; but they have fewer ſinuoſities than the nautilus, and they have no ſmall pipes that run through them to preſerve a communication one with another. There is alſo ſome difference in their covering; for the nautilus is very ſmooth, or at leaſt the ſtreaks of the ſurface only anſwer to the windings on the inſide, and are very broad; whereas Ammon's Horns have ſeveral external turns, are covered often with tubercles, and almoſt always with ſtreaks. There are plenty of the foſſile kind in the county of Oxford, which are of different colours, ſhapes and ſizes, but always ſo curled up, that the place of the head is in the circumference, and the tail is in the centre of the ſtone. Some are ſmall, with protuberant parts ſwelling almoſt to a round; others are broader and more depreſſed; but the lines in both are undulated, and extended from near the centre to a ſingle edged ridge on the back of the ſtone. In this reſpect they differ from a third ſort that has broader lines, but not undulated, and they terminate at the large protuberances on each ſide the ſtone, between which and the broad back thereof there run other lines; the whole body of the ſtone being likewiſe divided into ſutures not much unlike the leaves of an oak.

A ſort of theſe ſtones have been found in the pariſh of Cleydon in Oxfordſhire, which have many more turns than the former, though they are not much bigger; but they are without a covering, and are of a yellowiſh colour, with ſtreaks that run from the innermoſt part of the ſtone, and are all ſingle, except that ſome of them are divided into two parts before they reach the rim of the ſtone, where they terminate with a back much more protuberant than the reſt of the ſtone, though ſtreaked in the ſame manner. There are alſo others met with that are not ſtones like the former, but conſiſt of a fine ſtony earth, or hardened yellow clay; contrary to

the opinion of ſome authors, who affirm that they are all of the ſame conſiſtence.

The OPHIOMORPHITES nearly reſemble the former, and are ſo called from their being like ſerpents rolled up. Some of theſe are alſo found ſo ſoft, that it is eaſy to break them with the fingers; but there are others that conſiſt of a hard bluiſh ſtone. They differ from theſe in their lines or furrows; for in the former the ſtreaks are wider, and more open near the rim; but in ſome of theſe they are cloſer, and alſo united into pretty large protuberant knobs on each ſide the back of the ſtone, which in theſe is broad and ſomewhat riſing, and is croſſed by other crooked or curve lines that run between the eminences. There are other ſtones of this kind, that have only ſtraight ſingle ribs, which likewiſe terminate in ſtraight ridges, that run on each ſide the back of the ſtone; between which there is a third that is more prominent, and might be taken for the ſpine of the back; however, it is not wreathed, but plain like thoſe on each ſide of it. The largeſt of this kind in Oxfordſhire was found at Langford, near Oxford, and is eleven inches over, and weighs ſeventeen pounds. The ribs are ſingle, and there are no knobs or ridges at the back, which is plain and even.

The BELEMNITES are ſo called from the Greek word *Belemnon*, which ſignifies a dart, becauſe they are nearly of that ſhape. Authors are not agreed in what claſs to place this ſtone. The ſhape is, however, ſometimes conical, ſometimes cylindrical, and they moſt commonly conſiſt of a ſubſtance that is black and horny; the length is from two inches to eight, and the diameter from the ſixth part of an inch to three or four inches in circumference. The inward parts conſiſt of rays, and there is generally a cell at the large end, and a furrow that runs from the top to the bottom.

There are other ſtones that repreſent herbs and plants, among which are FUNGITES, or TUBEROIDES, ſo called from their reſemblance to muſhrooms: theſe are of an aſh colour without, but a black flint within. Others reſemble only the parts of plants, one of which has been met with like a root of briony broken off tranſverſely, which ſhewed the ſmall fibres that run from the centre to the circumference; as well as the other ſtreaks that run down the ſides, and the annular diviſions. The colour alſo is ſo like that of briony, that it can hardly be diſtinguiſhed from it, except by the weight. It was found in quarries of rubble-ſtone near Shotover-Hill in Oxfordſhire.

There are other ſtones like the fruit of trees, ſome of which are called PYRIFORMES, from their likeneſs to pears: one of theſe was found of eleven inches in circumference, and in ſize and form reſembling a king-pear. This was a black flint; but there is another that is whitiſh without, and yellow within, in the ſhape of a warden pear. Other ſtones have been found in the ſhape of apricots, with the cleft or furrow from the ſtalk to the top, exactly repreſenting a real apricot; likewiſe there have been ſpars found reſembling mulberries, and white flints in the ſhape of Lucca olives.

There are alſo ſtones in the ſhape of thoſe belonging to fruits. Moſt of theſe have a kind of pedicle or ſtalk, from which they ſeem to have had their growth, and are ridged and furrowed the whole length of the ſtone. Their texture is very curious, they being made up of little thin plates, not unlike the ſtone called the Selenite, only they are opaque, and the bulk of the ſtone much different. The plates ſeem to be made up of ſtrings, ſome of which run two ways, and others three, and according to their directions the ſtone will readily cleave; yet they are all oblique to the axis of the ſtone.

There are other ſtones that reſemble animals either entirely or in part, among which there are ſome that ſeem to have been petrified reptiles, and very likely have been really ſuch, which may eaſily be accounted for without the help of a flood. There are others that repreſent the ſhells of garden ſnails, and are very numerous. There are others called Worm-ſtones, which are of two ſorts, and one of them is of a whitiſh yellow colour, but not hollow within; for they ſeem to be of the ſame texture with the pebble-ſtones among which they are found.

There are ſome ſtones that repreſent the parts of four-footed beaſts; particularly in the quarries at Heddington there are ſome that are like the head of a horſe, having the ears and creſt of the mane, with the places of the eyes, as prominent as in a real horſe; and the reſt of the face entire, only the mouth and noſe are wanting in them all. Theſe are not uncommon, and they are of ſeveral ſizes; though they are not taken notice of by any ancient authors. There are other ſtones in the form of hearts, and on account of their ſize are by authors called Bucardites, or ſtones like bulls hearts. They are of a whitiſh yellow colour, with a ſmooth plain ſurface; though there are ſome that are ribbed on each ſide; theſe are ten inches in circumference, and weigh about two pounds; and there have been ſome found that have weighed twice as much.

Dr. Plott met with ſome ſort of ſtones in the quarries of the rubble-ſtone near Shotover, which were compoſed of filaments like hair; and which could not be the Polythrix of Pliny, becauſe they are not greeniſh, nor the Beſtrychites of Zoroaſter, nor the Corſoides of Pliny, becauſe they are neither grey nor long. However, it is a ſort of Thrichites, becauſe it is moſt like the ſhort hair of beaſts. The colour is yellowiſh, and each hair when viewed through a microſcope appears to be ſtreaked and furrowed throughout its whole length.

Some ſtones have been found accurately repreſenting the combs of bees, with the cells of each cavity all hexangular, exactly like thoſe of honeycombs. There was one ſtone found in a marl-pit that was very like a mole both in the head and tail, but more eſpecially in the foot; it was ſo very exact that it was divided into claws, and repreſented the foot of that animal in all particulars. Some have been found ſo nearly reſembling the head of an Owl, as almoſt to imitate life, having the eyes and beak of that animal very perfect. Another was of the ſhape and ſize of a partridge's ſkull, with the eyes and ſhort beak, and was hollowed behind juſt as if the brains had been taken out: to theſe may be added ſtill another, which was the accurate repreſentation of a pullet's heart, with the fat near the baſis thereof, and the coronary veſſels deſcending from it moſt exactly delineated. All theſe are taken notice of by Dr. Plott.

There are ſome ſtones that ſeem to belong to the oviparous quadrupeds, among which is the Buſonites or Toad-ſtone. Authors acquaint us there are two kinds of theſe, the firſt of which are thoſe that are called Brontiæ and Ombria, which are ſometimes of a duſky reddiſh, yellowiſh or greeniſh colour, of the ſize of a hen's egg. From the flat or the concave ſide there generally runs five lines to the centre of the convex ſide, at equal diſtances, and marked with exceeding ſmall tubercles.

There has been another ſtone found in the rubble-quarry near Shotover Hill, that is a lively repreſentation of olfactory nerves entire and whole: many of theſe are of a yellowiſh colour, ſmooth without, and hollow within. Dr. Plott found another of an oval ſhape, and chiefly of a reddiſh colour; but at one end it had a circle of white within, which is a zone of the colour of the ſtone, and then a round pupil of white, ſo that it looked like an eye darkened by a cataract.

There

There are other ſtones, which reſemble the ears of a man, though much leſs, and Dr. Plott calls them Otites or Auriculares; they are common in the rubble-quarries near Shotover, but more ſo in a bank near a ſpring at Somerton town's-end, eaſtward from the church. There are other ſtones met with in the ſhape of human breaſts, having not only the nipple, but the areola ſtudded with ſmall protuberances, and therefore may be properly called Mammillares.

There are other ſtones, which exactly reſemble the heart of a man, with the trunk of the deſcending part of the vena cava, as alſo the aſcending part of the vein of the ſame name. Likewiſe from the left ventricle there proceeded the trunk of the great artery, and a portion of the ſame artery tending downwards. Within it appeared to be a whitiſh ſort of flint, and certainly deſerves the name of Anthropocardites.

Other ſtones have been found exactly repreſenting the private parts of a man; and others in the ſhape of kidneys, with the trunk of one of the ureters deſcending from the hollow part of it. When found it was the colour of a kidney, and was ſo ſoft that it might be readily cut with a knife, that is, the part of it reſembling an ureter; but in leſs than an hour's time it grew as hard as the reſt of the ſtone. To this claſs may be added the Triorchites, or Diorchites, which reſemble the teſticles of man or beaſt

Some ſtones have been met with in the ſhape of human bones; particularly one exactly reſembling the lowermoſt part of the thigh-bone of a man, with the lower head; between which are the anterior and the larger poſterior ſinus, which is the ſeat of the ſtrong ligament that riſes out of the thigh, and that allows a paſſage to the veſſels deſcending into the leg. A little above the ſinus, where the bone ſeems to have been broken off, there is a ſhining ſpar-like ſubſtance, reſembling marrow in the hollow of the bone. Its circumference near the head is exactly two feet, and at the top above the ſinus about fifteen inches, and the weight is near twenty pounds; which ſhews that the bulk is too monſtrous to have belonged to a man, though it is preciſely of the ſame ſhape. With this there was found a tooth that weighed two ounces and a quarter; but it was not at all petrified, which perhaps may be owing to the nature of teeth, whoſe hardneſs and want of large pores do no ſo readily ſubject them to putrification: for the ſame reaſon in graves they are often found ſound and good, when all the other parts have been conſumed. Not far from Bath in Somerſetſhire, there have been hatfuls of teeth picked up by thoſe who followed the plough, though no other bones were met with to which they might have been ſuppoſe to belong. We are informed by Tazellus in his hiſtory of Sicily, that two large ſkeletons were found, which, when they came to be touched, all fell into duſt, except the teeth called the grinders, What animal the thigh-bone above mentioned did belong to is hard to ſay, though ſome have taken it to be the bone of an elephant brought over by the Romans when they were maſters of this kingdom. However, it does not appear from any authors, that thoſe animals were ever brought over into Britain; and yet it cannot be denied that ſeveral have been brought over hither for public ſhews: but whether any died in Oxfordſhire, and were there buried, muſt be left to the judgment of the reader.

There has been a great number of monſtrous teeth found in different parts of England; and in Eſſex there were two met with in the reign of Richard I which were large enough to make two hundred each of the common ſize. One dug up near Maidſtone in Kent was near ſeven inches in circumference, and weighed five ounces and one eighth. In the year 1666, after the fire of London, when St. Mary Woolchurch was pulled down, there was a thigh-bone found larger than the above-mentioned, which however was not turned to ſtone. There was alſo another found in London three feet and two inches long. After all, we may be certain that theſe bones did not belong to elephants, becauſe they are of a quite different ſhape, which has been found by comparing them together; and therefore Dr. Plott was of opinion they belonged to men or women. To ſupport his opinion, he takes notice of the ſizes of the ſeveral giants that have been mentioned by authors; and he likewiſe mentions a giant in France, who lived there about two hundred years ago: this man was ſaid to be ſo tall, that a man of a common ſtature might go upright between his legs.

Dr. Plott likewiſe takes notice of a ſtone found at the foot of Shotover Hill, which repreſents the leg and foot of a man cut off above the ancle, and which from the toe to the heel is about a yard long. However, he does not take this to be a petrification, but a ſtone formed in this ſhape by the plaſtic power of nature.

Beſides theſe ſtones reſembling the parts of animals, there are others not unlike things made by art. Among theſe are ſome of the ſhape of buttons, and others like the heel of an old ſhoe, with the lifts plainly diſtinguiſhed from each other. One of the button ſtones was found at Teynton in Oxfordſhire, pretty near reſembling a hair button.

Other ſtones have been ſeen like the bags called the Sleeves of Hippocrates, made uſe of by the chemiſts; and there have been three one above another, as they uſually place them. Others have been found in the ſhape of a whetſtone; and ſome in that of a cap. There is another ſtone of an aſh colour called Trochites, from its likeneſs to a wheel; for it has rays or ſpokes which proceed from the center, like thoſe of a cart-wheel from its nave. Some of theſe are called Entrochi, or Wheels within Wheels; the rays of one of the Trochites being in relievo, and always lying in the furrows between the two protuberances of the other, as in the ſutures of a ſcull. The round part is ſmooth, and the nave is flat; from which, as in common wheels, the prominent rays proceed to the outward circumference, ſo as to leave furrows between them. They are joined together ſo curiouſly, that they ſeem to be the effect of art; for the ſpokes of one are inſerted in the furrows of the other, ſo as to repreſent the ſutures of a human ſcull. Sometimes there are twenty united together in this manner. When the Entrochos is ſmooth in every part, the ſpokes are prominent. Theſe ſtones differ in colour from each other; for ſome are white, others aſh-coloured, and others again yellow: they differ alſo in ſize, for the largeſt are near an inch broad, and about a third as much thick. It is found in Saxony, in the clefts of marble, of a whitiſh aſh-colour.

The Entrochi of Staffordſhire are much larger, longer, and conſequently compounded of more trochites, than thoſe of Yorkſhire or Somerſetſhire; for ſome are three inches and a half in circumference, whoſe center or nave is half an inch over. One found in a rock was near ſix inches long, but it was ſo faſt incloſed that it could not be got out entire. Some of two inches and a half long conſiſted of thirty-five trochites.

At Beresford, and other places in Staffordſhire, there are ſtones that ſeem to be made up of thick trochites, that have no bore at all, nor any rays at the top proceeding from a ſolid centre; which is no wonder, becauſe when they are broken they do not ſeem to conſiſt of plates like the reſt. There is another ſort that ſeem to be made up of joints like the Entrochi, in which the trochites neither appear round nor ſquare on their outermoſt rims, but ſharp

like the edge of a ſcrew, tapering from the place of their joining, and are ſtreaked on their ſurfaces; ſo that the rays of one do not enter into the furrows of the other, nor yet do the rays join to the centre at right angles; and this in theſe is a large cylinder of black flint. Neither are all theſe cylindrical as the former; for ſome of them taper upwards from a broad baſis, the lowermoſt rims being greateſt, and decreaſing gradually to the top. Some of theſe are ſo different from the former, that they have a thin ſtreaked plate paſſing from each rim to the ſides of the cylindrical concavity; ſo that there appears a diſtinct concavity between each ring. Some again have others included within them, and appear like rings parallel to each other, and not like a ſcrew, nor do the protuberant edges of the one enter into the furrows of the other, like the male and female ſcrews.

Some ſorts of theſe ſtones, that have ſuch cavities, are in the form of five columns joined together without any addition; and others are bound by thin rings that ſtand pretty thick and at equal diſtances, which are not ſtreaked. Some again are knit together by the ſame ſort of rings, that are only in pairs, there being ſome diſtance between each pair; and others have four placed in the ſame manner. There is ſtill another ſort fenced in the ſame way, ſome of which are of an equal bigneſs from the bottom to the top, and are curiouſly wrought in ſmall rings, firſt with two at ſome diſtance, and then with four cloſe together; and ſo on alternately the whole length of the ſtone: but others, though like the former in other reſpects, are bigger both at the top and at the bottom, and reſemble a pillar with a pedeſtal and capital. Laſtly, there are ſome very ſmall ones, that ſtand in cavities like ſtraight ſmooth pillars, only they are marked with a row of knobs on each ſide; and there are others that look like ſo many buttons piled upon each other.

ASTERIÆ, or STAR-STONES, are found in ſeveral parts of the kingdom, and particularly in the fields about Cleydon in Oxfordſhire. They conſiſt of thin plates lying obliquely to the horizontal poſition, much after the manner of the Jews Stone; and the colour is various, according to the different ſoils in which they are found: for this reaſon, in Gloceſterſhire and Yorkſhire, where they are taken out of a blue clay, they are nearly of the ſame colour, and break like flints with a dark ſhining ſurface. In Warwickſhire, as well as in ſome parts of Glouceſterſhire, they are of an aſh colour; and at Cleydon they are yellowiſh, becauſe they are found in a yellowiſh earth. They are here about an inch and a half in length, and ſeldom leſs than an inch in circumference: and whereas in other countries they are ſo hard, that it is difficult, if at all poſſible, to ſeparate one from another without ſpoiling them; yet if theſe are ſteeped in vinegar for a night, they may be divided the next morning with ſafety and eaſe. They likewiſe differ from thoſe of other places in ſhape; for, beſides the ſculpture that makes up the angles, there is the repreſentation of a roſe in the middle thereof, which is not commonly ſeen in thoſe found elſewhere.

Many of the longeſt jointed Star-Stones have ſome of their joints a little broader and more prominent than others, dividing the whole body as it were into certain conjugations of two, three, or more joints, which, as Dr. Liſter obſerves, are marked with ſets of wires, as he calls them.

The Star-Stones found in Staffordſhire are exactly of the ſame ſhape, in which ſtars are commonly painted; for they have all five principal rays of an equal length, ſhape, and make, and proceeding from the centre, which is either ſolid or hollow, and where they join in angles of ſeventy-two degrees. They differ ſomewhat from each other in the different places where they are found, as alſo from thoſe in Oxforſhire, as well as from thoſe taken notice of by Dr. Liſter in the Philoſophical Tranſactions; for though they are placed on each other in columns, and ſeem to be fragments, ſome having three, four, or more joints, yet none of them ſeem to be made up of plates lying obliquely to the horizontal poſition of the ſtar; and ſome of them have their angles ſo very accute, and conſequently their ſides ſo deeply furrowed, that they ſeem to repreſent the rowel of a ſpur, without any ſculpture or indented future; but when there is any ſuch, they are of a quite different kind from thoſe already mentioned.

The firſt ſort are placed in a caſe of a flinty kind of ſtone, conſiſting of five angles; and the rays proceed from a ſolid centre, of a coal-black colour, not bigger than a common pin; yet they are evidently of a flat figure, conſiſting of five angles; though the angles of the inner one do not point againſt the ſharp rays of the outer, but againſt the deep furrows between them; however, they are both ſmoothly jointed, without any hatching or engraving.

The ſecond ſort conſiſts of a flat and not hollow-ſided piece, ſuch as Dr. Liſter has deſcribed in the Philiſophical Tranſactions; and the hatchings thereof are very different from all his. There is one principal ray which extends itſelf from the centre to the extremity of each angle, with oblique lines proceeding upwards therefrom, in ſuch a manner that they in ſome ſenſe repreſent ſo many boughs of a tree.

The third kind has alſo flat ſides; but the joints are all unequal, one of them being always more protuberant than the next, and ſo alternately throughout the whole column. It conſiſts of twelve joints, and the hollow of each angle is neither hatched on the top, nor is the column bent, or the leaſt inclining, as thoſe commonly are which are of a greater length. Theſe have the property of moving in vinegar, like the former; and this property ſeems to have been known to Roger Bacon near five hundred years ago; for in one of his epiſtles he affirms they would run in vinegar.

The ASTROITES are a kin to the Aſteriæ, and are of different ſizes, but are adorned all over with many ſtars; and there are no leſs than four different kinds found in Oxfordſhire, in two whereof the ſtars are in mezzo-relievo, they being prominent and ſtanding outwards, with the ſtreaks deſcending from the center at the top and all ſides to the rock on which they grow. Some of theſe are of a larger and others of a ſmaller kind, which are both found in the quarries of rubble-ſtone. There is a third ſort, which are more beautiful than the reſt, and are deeply engraved like a ſeal, and ſtreaked from the prominent edges above, to a centre in the bottom. Theſe are generally hexagons, and ſometimes pentagons; and yet they agree with the former in this, that the ſtars are only ſuperficial, and not found in the body of the ſtone.

The fourth ſort has been imperfectly deſcribed by Geſner, and after him by ſeveral others. The ſtreaks of theſe are like the third ſort, deſcending in a concave; but from the edges are generally round, or with five angles at the top, and tend to a center, but not of their own kind, for they are ſmooth and apparently prominent. They are found in quarries of rubble-ſtone, and are ſtellated, not only on the ſurface of the ſtone, but quite through the depth thereof; yet not ſo as to have one continued ſtar reach through the whole, but many, according to the thickneſs of the ſtone; for about ten of them lie in the depth of an inch, much after the ſame manner as the ſtar-ſtones; only they are not ſeparate, but join together, and make as it were ſo many rows

of the ſtone. Some of theſe are ſo large in France, that they have been there uſed for the building of walls and houſes; but with us they are generally employed in paving cauſeways, particularly in Oxfordſhire.

The property of moving in vinegar is common both to the Aſteriæ and the Aſtroits; though the Aſteriæ will move not only in a whole joint, but two or three connected together; whereas the Aſtroits muſt be broken into very ſmall pieces before they will move. The Aſteriæ has not only a progreſſive motion, but will turn round in vinegar, and will ſtir more briſkly and longer than any other ſtone that vinegar has the like effect upon; and though it has been ſteeped therein for three or four days, yet when freſh is poured upon it, it will ſtill emit a great many little bubbles as at firſt from underneath it, and at the inſtant it begins to move.

Linnæus places the LAPIS JUDAICUS, or JEWS STONE, among petrifications; and Boet informs us that it is in the ſhape of an olive, and is roundiſh. tender, and brittle, with ſtreaks that run according to the length, and placed at equal diſtances, as if they were done by art. The colour is whitiſh, or a faint aſh colour, ſhining within, and it may be obliquely cloven into foliaceous plates. It is called a Jews Stone, becauſe it has been found in Judæa, and other parts of Syria; but ſome of theſe have been found in England, particularly in Oxfordſhire, which are of a more ſlender and longer ſhape than any ſort of olive. Some are about two inches in length, and an inch and a half in circumference; but others have been met with leſs than an inch long, and not much above half an inch round. Moſt of them have a kind of pedicle or ſtalk, from which they ſeem to have had their growth, and there are ridges or furrows through the whole length of the ſtone. The ridges are marked with ſmall knots, in four points placed in a ſquare, and a fifth in the middle. Their texture is very curious, for they conſiſt of thin plates, as above, not unlike the ſelenites, only they are opaque.

Linnæus likewiſe places CORAL, Madrepore, and the like, among petrifications: and he calls them Lithophytes, though they have been commonly placed among ſea plants. Thoſe of the Coral kind are a little flexible, like wood, when in the water, and to a ſmall degree when out of it; but they may be reduced into powder like chalk. There are a great many of this kind, which reſemble ſmall trees without leaves: others are in the form of a net, ſometimes with large meſhes, and ſometimes with ſmall. The inſide of the branches ſeem to be of the nature of horn; for it has the ſame ſmell when put into the fire: but the bark is of a ſtony nature, and contains a great deal of ſalt. Coral, properly ſo called, is of a ſtony nature, and is placed in the animal kingdom, becauſe it produces ſea inſects. Some of theſe are red, and others white, and others of various colours. However, the red, of the colour of vermillion, is beſt, and is by ſome ſaid to be of the male kind, and that which is paliſh of the female. The white Coral is the next in value, and then the black; but thoſe of the other colours ſome will not allow to be Corals, though they are found in the ſame places. It is always covered with a bark, and is ſtony, ſolid, and very hard, even in the water; though the branches are a little flexible, but ſoon grow hard in the air. The bark of Coral is a mixture of tartar and a fluid of a gluey nature; and though it is a little rough, it takes a very fine poliſh. Some take the black Coral to be the ſea plant of a different nature.

Red Coral is not ſo much eſteemed in Europe as it is in Aſia, and particularly in Arabia. It is uſed for making ſeveral ſorts of toys, ſuch as ſpoons, heads of canes, knife-handles, ſword-hilts, and beads; and, when ſet in ſilver, it ſerves as a plaything for children, and is deſigned to rub their gums therewith, that they may breed their teeth more eaſily.

On the young branches of Coral there are found ſmall eminences, pierced in the form of ſtars, and full of a milky fluid when they are juſt taken out of the water. Many learning men have thought ſea plants to be nothing but petrifications, conſiſting of plates of ſalt, and layers of tartar, placed one upon another; and as coral always grows with its head downwards, in caverns of rocks in the ſea, the ſituation has cauſed them to ſuſpect that they were nothing elſe but petrifications like thoſe found on the roofs of certain caves in the rocks. But ſince the diſcovery of the flowers of coral, and ſome other marine productions, it is not at all doubted but they have a regular organization; and if their ſeeds have not yet been perceived, it is becauſe their ſmallneſs renders them imperceptible.

But ſome have thought that the generation of theſe plants is not owing to theſe ſeeds; becauſe, as they always hang with their heads downwards, they would fall off to the bottoms of the caverns, and not place themſelves on the top; but this difficulty may be removed, by ſuppoſing they are lighter than the ſea water, and that the milk which ſurrounds them is of ſo thick a nature, that it may help to aſſiſt them in ſwimming. Hence indeed it may happen, that many of them may riſe to the top of the water, and there periſh; but then likewiſe others may aſcend to the top of the caverns, and there fix themſelves, and then they will grow like the coral from which they proceed. Hence we may conclude, from the regularity of theſe productions, the organization of their parts, the great numbers of ſmall pores in their bark to receive the bitumen and other ſea juices, the eminences regularly hollowed in the form of ſtars, which ſerve for the caſes of flowers in the ſame ſhape, the veſſels full of a milky fluid which is found between the bark and the body of the plant, to make it grow thicker by little and little, and the perpetual uniformity of the ſame circumſtances; we ſay, from all theſe particularities we have reaſon to believe, that the bottom of the ſea is covered with plants, with characteriſtics different from ours. In Spain they have a particular ſort of a machine for the getting of Coral, particular at a promontory in Catalonia. This is a wooden croſs which is very large, and in the centre there is a wooden ball of a great weight, to which a very long and thick rope is faſtened. At each end of the croſs they hang a net in the form of a bag, which being let down into the ſea, there are proper perſons, who know where the Coral is to be found, and have the care of managing the rope. They guide one or more ends of the croſs into the caverns, and then the nets lay hold of the Coral, break it off, and let it fall into the hollow part of the net; and when they have got as much as can well be contained in each of them, the machine is drawn up. The Red Coral is only choſen for medicinal uſes, and many authors have aſcribed great virtues thereto, which are in a great meaſure imaginary; however, it cannot be denied that it is a good abſorbent, and therefore is proper to reſtrain the orgaſm of the blood, and to blunt the acrimony of the bile and other humours in various ſorts of fluxes, as well as for the gripes in children. Its doſe is from a ſcruple to a drachm.

The MADREPORE has no bark like the former, but it is branched like it, though the branches are not ſo numerous. There are ſeveral ſorts of them, and ſome are only a thick plate of a hardiſh ſtony matter, pierced with a great number of holes or pores, which are diſpoſed in the form of ſmall pipes, waves, ſtars, and other figures; but it is moſt commonly in the ſhape of a ſmall tree, and the branches

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are always full of holes or pores. It is found in various parts of the world, but no where in ſuch great plenty as near the Caribbee iſlands.

There are ſeveral ſorts of them, as the ſtellated Madrepore akin to Coral; the branched Madrepore akin to Coral; the Madrepore or Millepore of Tournefort; the common Madrepore or fiſtulous white Coral; the Madrepore like ſouthernwood; the warty-pointed Madrepore, by ſome called the water-pointed white Coral; and the white ſtellated Madrepore.

Though Madrepore is generally found growing in the ſea, yet it is ſometimes found on the tops of mountains: that met with by Juſſieu on Mount Chaumont in Normandy was porous, light, white, and in all reſpects like the common Madrepore. It is, like moſt petrifications, alkaline and abſorbent, and has much the ſame virtues as Coral. In fluxes of the belly, the doſe is from half a ſcruple to two ſcruples.

We cannot conclude this Hiſtory of Minerals, &c. without paying that juſt tribute, which is due to the wiſe Author of Nature, who has not only provided man with every thing that is neceſſary either for his uſe or amuſement, but has furniſhed him with reaſon to enquire into their various properties. The beaſts of the field either aſſiſt him in the eaſe of this labour, or ſupply him with the moſt nouriſhing food; the inhabitants of the air above him, and thoſe of the waters beneath, furniſh his table with the moſt delicate repaſts; the earth affords him the moſt wholeſome vegetables, which preſerve the temperature of his body, and relieve thoſe diſorders which ariſe from too free a uſe of groſſer food; beneath his feet, and deep in the bowels of the earth, inexhauſtible treaſures lie hid, ſuch as gold, ſilver, and the moſt precious jewels; iron, to ſecure him in his habitation from aſſaſſination and plunder, and to make him every kind of inſtrument indiſpenſibly neceſſary in agriculture, navigation, and mechanical arts. Vain indeed is the attempt to enumerate, in a few lines, thoſe wonders of the creation! Let us, however, from what we have read, draw this concluſion, that, in proportion as we increaſe our knowledge of natural cauſes, the more elevated idea ſhall we have of him, who is the author of them all.

A NEW

A

NEW, COMPLETE, and UNIVERSAL BODY, or SYSTEM of

NATURAL HISTORY;

Being a Grand, Accurate and Extenſive

Diſplay of Animated Nature.

B O O K VI.

Containing the THEORY *of the* EARTH *in general.*

THE general hiſtory of the Earth, is a neceſſary ſtudy for thoſe who deſire to make themſelves acquainted with nature and her productions, and the detail of ſingular circumſtances of the life and manners of animals, or of the culture and vegetation of plants, belong perhaps, leſs to natural hiſtory than to the general reſults of obſervations made on the different matters which compoſe the terreſtrial globe; the eminences, depths, and inequalities of its form, the motion of the ſea, the direction of mountains, the poſition of quarries, the rapidity and effects of currents, &c. This is nature in its ample extent, and theſe are her principal operations; they influence all the reſt, and the theory of theſe effects is a firſt ſcience of which the intelligence of particular phenomena, as well as the exact knowledge of terreſtrial ſubſtances depends.

CHAP. I.

Containing a Sketch of the UNIVERSE.

THE world may be conſidered as one vaſt manſion, where man has been admitted to enjoy, to admire, and to be grateful. The firſt deſires of ſavage nature are merely to gratify the importunities of ſenſual appetite, and to neglect the contemplation of things, barely ſatisfied with their enjoyment: the beauties of nature, and all the wonders of creation, have but little charms for a being taken up in obviating the wants of the day, and anxious for precarious ſubſiſtence.

Philoſophers, therefore, who have teſtified ſuch ſurprize at the want of curioſity in the ignorant, ſeem not to conſider that they are uſually employed in making proviſions of a more important nature; in providing rather for the neceſſities than the amuſements of life. It is not till our more preſſing wants are ſufficiently ſupplied, that we can attend to the calls of curioſity; ſo that in every age ſcientific refinement has been the lateſt effort of human induſtry.

But human curioſity, though at firſt ſlowly excited, being at laſt poſſeſſed of leiſure for indulging its propenſity, becomes one of the greateſt amuſements of life, and gives higher ſatisfactions than what even the ſenſes can afford. A man of this diſpoſition turns all nature into a magnificent theatre, replete with objects of wonder and ſurprize, and fitted up chiefly for his happineſs and entertainment: he induſtriouſly examines all things, from the minuteſt inſect to the moſt finiſhed animal; and, when his limited organs can no longer make the diſquiſition, he ſends out his imagination upon new enquiries.

Nothing, therefore, can be more auguſt and ſtriking than the idea which his reaſon, aided by his imagination, furniſhes of the univerſe around him. Aſtronomers tell us, that this earth which we inhabit forms but a very minute part in that great aſſemble of bodies of which the world is compoſed. It is a million of times leſs than the ſun, by which it is enlightened. The planets alſo, which like it, are ſubordinate to the ſun's influence, exceed the earth a thouſand times in magnitude. Theſe, which were at firſt ſuppoſed to wander in the heavens without any fixed path, and took their name from their apparent deviations, have long been found to perform their circuits with great exactneſs and ſtrict regularity. They have been diſcovered as forming with our earth a ſyſtem of bodies circulating round the ſun, all obedient to one law, and impelled by one common influence.

Modern philoſophy has taught us to believe that, when the great Author of nature began the work of creation, he choſe to operate by ſecond cauſes; and, that, ſuſpending the conſtant exertion of his power, he endued matter with a quality by which the univerſal œconomy of nature might be continued, without his immediate aſſiſtance. This quality is called attraction; a ſort of approximating influence, which all bodies, whether terreſtrial or celeſtial, are found to poſſeſs; and which in all increaſes as the quantity of matter in each increaſes. The ſun, by far the greateſt body in our ſyſtem, is, of conſequence, poſſeſſed of much the greateſt ſhare

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of this attracting power; and all the planets of which our earth is one, are of courſe, entirely ſubject to its ſuperior influence. Were this power, therefore, left uncontrouled by any other, the ſun muſt quickly have attracted all the bodies of our celeſtial ſyſtem to itſelf; but it is equably counteracted by another power of equal efficacy; namely a progreſſive force which each planet received when it was impelled forward, by the divine architect, upon its firſt formation. The heavenly bodies of our ſyſtem being thus acted upon by two oppoſing powers; namely, by that of attraction, which draws them towards the ſun; and that of impulſion, which drives them ſtrait forward into the great void of ſpace; they purſue a track between theſe contrary directions; and each like a ſtone whirled about in a ſling, obeying two oppoſite forces, circulates round its great centre of heat and motion.

In this manner, therefore, is the harmony of our planetary ſyſtem preſerved. The ſun, in the midſt, gives heat, and light, and circular motion to the planets which ſurround it: Mercury, Venus, the Earth, Mars, Jupiter, and Saturn, perform their conſtant circuits at different diſtances, each taking up a time to complete its revolutions proportion to the greatneſs of the circle which it is to deſcribe. The leſſer planets alſo, which are attendants upon ſome of the greater, are ſubject to the ſame laws; they circulate with the ſame exactneſs; and are, in the ſame manner, influenced by their reſpective centres of motion.

Beſides thoſe bodies which make a part of our peculiar ſyſtem, and which may be ſaid to reſide within its great circumference; there are others, that frequently come among us, from the moſt diſtant tracts of ſpace, and that ſeem like dangerous intruders upon the beautiful ſimplicity of nature. Theſe are comets, whoſe appearance was once ſo terrible to mankind, the theory of which is better underſtood at preſent: we know that their number is much greater than that of the planets; and that, like theſe, they roll in orbits, in ſome meaſure, obedient to ſolar influence. Aſtronomers have endeavoured to calculate the returning periods of many of them; but experience has not, as yet, confirmed the veracity of their inveſtigations: indeed, who can tell when thoſe wanderers have made their excurſions into other worlds and diſtant ſyſtems, what obſtacles may be found to oppoſe their progreſs, to accelerate their motions, or retard their return?

But what we have hitherto attempted to ſketch, is but a ſmall part of that great fabric in which the Deity has thought proper to manifeſt his wiſdom and omnipotence. There are multitudes of other bodies diſperſed over the face of the heavens, that lie too remote for examination: theſe have no motion, ſuch as the planets are found to poſſeſs, and are therefore, called fixed ſtars; and from their extreme brilliancy and their immenſe diſtance, philoſophers have been induced to ſuppoſe them to be ſuns reſembling that which enlivens our ſyſtem; as the imagination alſo, once excited, is ſeldom content to ſtop, it has furniſhed each with an attendant ſyſtem of planets belonging to itſelf, and has even induced ſome to deplore the fate of thoſe ſyſtems, whoſe imagined ſuns, which ſometimes happens, have become no longer viſible.

But conjectures of this kind, which no reaſoning can aſcertain, nor experiment reach, are rather amuſing than uſeful. Though we ſee the greatneſs and wiſdom of the Deity in all the ſeeming worlds that ſurround us, it is our chief concern to trace him in that which we inhabit. The examination of the earth, the wonders of its contrivance, the hiſtory of its advantages, or of the ſeeming defects in its formation, are the proper buſineſs of the natural hiſtorian. A deſcription of this earth, its animals, vegetables, and minerals, is the moſt delightful entertainment the mind can be furniſhed with, as it is the moſt intereſting and uſeful. We would beg leave, therefore, to conclude theſe common-place ſpeculations, with an obſervation, which is not entirely ſo.

An uſe, hitherto not much inſiſted upon, that may reſult from the contemplation of celeſtial magnificence, is, that it will teach us to make an allowance for the apparent irregularities we find below. Whenever we can examine the works of the Deity at a proper point of diſtance, ſo as to take in the whole of his deſign, we ſee nothing but uniformity, beauty, and preciſion. The heavens preſent us with a plan, which; though inexpreſſibly manificent, is yet regular beyond the power of invention. Whenever, therefore, we find any apparent defects in the earth, which we are about to conſider, inſtead of attempting to reaſon ourſelves into an opinion that they are beautiful, it will be wiſe to ſay, that we do not behold them at the proper point of diſtance, and that our eye is laid too cloſe to the objects to take in the regularity of their connexion. In ſhort, we may conclude that God, who is regular in his great productions, acts with equal uniformity in the little.

CHAP. II.

Containing a ſhort Survey of the GLOBE, from the light of Aſtronomy and Geography.

ALL the ſciences are in ſome meaſure linked with each other, and before the one is ended the other begins. In a natural hiſtory, therefore of the earth, we muſt begin with a ſhort account of its ſituation and form, as given us by aſtronomers and geographers: it will be ſufficient however, upon this occaſion, juſt to hint to the imagination, what they, by the moſt abſtract reaſonings, have forced upon the underſtanding. The earth we inhabit is, as has been ſaid before, one of thoſe bodies which circulate in our ſolar ſyſtem; it is placed at an happy middle diſtance from the centre; and even ſeems in this reſpect, priviledged beyond all other planets that depend upon our great luminary for their ſupport. Leſs diſtant from the ſun than Saturn, Jupiter, and Mars, and yet leſs parched up than Venus and Mercury, that are ſiuate too near the violence of its power, the earth ſeems in a peculiar manner to ſhare the bounty of the Creator: it is not, therefore, without reaſon, that mankind conſider themſelves as the peculiar objects of his providence and regard.

Beſides that motion which the earth has round the ſun, the circuit of which is performed in a year, it has another upon its own axle, which it performs in twenty-four hours. Thus like a chariot-wheel, it has a compound motion; for while it goes forward on its journey, it is at the ſame time turning upon itſelf. From the firſt of theſe two ariſe the grateful viciſſitude of the ſeaſons; from the ſecond, that of day and night.

It may be alſo readily conceived that a body thus wheeling in circles will moſt probably be itſelf a ſphere. The earth, beyond all poſſibility of doubt, is found to be ſo. Whenever its ſhadow happens to fall upon the moon, in an eclipſe, it appears to be always circular, in whatever poſition it is projected: and it is eaſy to prove, that a body which in every poſition makes a circular ſhadow, muſt itſelf be round. The rotundity of the earth may be alſo proved from the meeting of two ſhips at ſea: the top-maſt of each are the firſt parts that are diſcovered by both, the under parts being hidden by the convexity of the globe which riſes between them. The ſhips in this inſtance may be reſembled to two

men who approach each other on the oppoſite ſides of an hill: their heads will firſt be ſeen, and gradually as they come nearer they will come intirely into view.

However, though the earth's figure is ſaid to be ſpherical, we ought only to conceive it as being nearly ſo. It has been found in the laſt age to be rather flatted at both poles, ſo that its form is commonly reſembled to that of a turnep. The cauſe of this ſwelling of the equator is aſcribed to the greater rapidity of the motion with which the parts of the earth are there carried round; and which, conſequently, endeavouring to fly off, act in oppoſition to central attraction. The twirling of a mop may ſerve as an homely illuſtration; which, as every one has ſeen, ſpreads and grows broader in the middle as it continues to be turned round.

As the earth receives light and motion from the ſun, ſo it derives much of its warmth and power of vegetation from the ſame beneficent ſource. However, the different parts of the globe participate of theſe advantages in very different proportions, and accordingly put on very different appearances; a polar proſpect, and a landſcape at the equator, are as oppoſite in their appearances as in their ſituation.

The polar regions, that receive the ſolar beams in a very oblique direction, and continue for one half of the year in night, receive but few of the genial comforts which other parts of the world enjoy. Nothing can be more mournful or hideous than the picture which travellers preſent of thoſe wretched regions. The ground, which is rocky and barren, rears itſelf in every place in lofty mountains and inacceſſible cliffs, and meets the mariner's eye at forty leagues from ſhore. Theſe precipices, frightful in themſelves, receive an additional horror from being conſtantly covered with ice and ſnow, which daily ſeem to accumulate and to fill all the vallies with increaſing deſolation. The few rocks and cliffs, that are bare of ſnow, look at a diſtance of a dark brown colour, and quite naked. Upon a nearer approach, however, they are found replete with many different veins of coloured ſtone, here and there ſpread over with a little earth, and a ſcanty portion of graſs and heath. The internal parts of the country are ſtill more deſolate and deterring. In wandering through theſe ſolitudes, ſome plains appear covered with ice, that, at firſt glance, ſeem to promiſe the traveller an eaſy journey. But theſe are even more formidable and more unpaſſable than the mountains themſelves, being cleft with dreadful chaſms, and every where abounding with pits that threaten certain deſtruction. The ſeas that ſurround theſe inhoſpitable coaſts, are ſtill more aſtoniſhing, being covered with flakes of floating ice, that ſpread like extenſive fields, or that riſe out of the water like enormous mountains. Theſe, which are compoſed of materials as clear and tranſparent as glaſs, aſſume many ſtrange and fantaſtic appearances. Some of them look like churches or caſtles, with pointed turrets; ſome like ſhips in full ſail; and people have often given themſelves the fruitleſs toil to attempt piloting the imaginary veſſels into harbour. There are ſtill others that appear like large iſlands, with plains, valleys, and hills, which often rear their heads two hundred yards above the level of the ſea; and although the height of theſe be amazing, yet their depth beneath is ſtill more ſo; ſome of them being found to ſink three hundred fathom under water.

The earth preſents a very different appearance at the equator, where the ſun-beams, darting directly downwards, burn up the lighter ſoils into extenſive ſandy deſerts, or quicken all the moiſter tracts with incredible vegetation. In theſe regions, almoſt all the ſame inconveniencies are felt from the proximity of the ſun, that in the former were endured from its abſcence. The deſerts are intirely barren, except where they are found to produce ſerpents, and in ſuch quantities, that ſome extenſive plains ſeem almoſt entirely covered with them.

It not unfrequently happens alſo that this dry ſoil, which is ſo parched and comminuted by the force of the ſun, riſes with the ſmalleſt breeze of wind; and the ſands being compoſed of parts almoſt as ſmall as thoſe of water, they aſſume a ſimilar appearance, rolling onward in waves like thoſe of a troubled ſea, and overwhelming all they meet with inevitable deſtruction. On the other hand, thoſe tracts which are fertile, teem with vegetation even to a noxious degree. The graſs riſes to ſuch an height as often to require burning; the foreſts are impaſſable from underwoods, and ſo matted above, that even the ſun, fierce as it is, can ſeldom penetrate. Theſe are ſo thick as ſcarce to be extirpated; for the tops being ſo bound together by the climbing plants that grow round them, though an hundred ſhould be cut at the bottom, yet not one would fall, as they mutually ſupport each other. In theſe dark and tangled foreſts, beaſts of various kinds, inſects in aſtoniſhing abundance, and ſerpents of ſurpriſing magnitude, find a quiet retreat from man, and are ſeldom diſturbed except by each other.

In this manner the extremes of our globe ſeem equally unfitted for the comforts and conveniencies of life; and, although the imagination may find an awful pleaſure in contemplating the frightful precipices of Greenland, or the luxurious verdure of Africa, yet true happineſs can only be found in the more moderate climates, where the gifts of nature may be enjoyed without incurring danger in obtaining them.

It is in the temperate zone, therefore, that all the arts of improving nature, and refining upon happineſs, have been invented: and this part of the earth is, more properly ſpeaking, the threatre of natural hiſtory. Although there be millions of animals and vegetables in the unexplored foreſts under the line, yet moſt of theſe may for ever continue unknown, as curioſity is there repreſſed by ſurrounding danger. But it is otherwiſe in theſe delightful regions which we inhabit, and where this art has had its beginning. Among us there is ſcarce a ſhrub, a flower, or an inſect, without its particular hiſtory; ſcarce a plant that could be uſeful which has not been propagated; nor a weed that could be noxious which has not been pointed out.

CHAP. III.

Containing a View of the Surface of the EARTH.

IF we take a ſlight ſurvey of the ſurface of our globe, a thouſand objects offer themſelves, which, though long known, yet ſtill demand our curioſity. The moſt obvious beauty that every where ſtrikes the eye is the verdant covering of the earth, which is formed by an happy mixture of herbs and trees of various magnitudes and uſes. It has been often remarked that no colour refreſhes the ſight ſo much as green; and it may be added, as a further proof of the aſſertion, that the inhabitants of thoſe places where the fields are continually white with ſnow, generally become blind long before the uſual courſe of nature.

This advantage, which ariſes from the verdure of the fields, is not a little improved by their agreeable inequalities. There is ſcarce two natural landſcapes that offer proſpects entirely reſembling each other; their riſings and depreſſions, their hills and valleys, are never entirely the ſame, but always offer

fer ſomething new to entertain and refreſh the imagination.

But to increaſe the beauties of the face of nature, the landſcape is enlivened by ſprings and lakes, and interſected by rivulets. Theſe lend a brightneſs to the proſpect; give motion and coolneſs to the air; and, what is much more important, furniſh health and ſubſiſtence to animated nature.

Such are the moſt obvious and tranquil objects that every where offer: but there are objects of a more awful and magnificent kind; the Mountain riſing above the clouds, and topt with ſnow; the River pouring down its ſides, increaſing as it runs, and loſing itſelf, at laſt, in the ocean; the Ocean ſpreading its immenſe ſheet of waters over one half of the globe, ſwelling and ſubſiding at well-known intervals, and forming a communication between the moſt diſtant parts of the earth.

If we leave thoſe objects that ſeem to be natural to our earth, and keep the ſame conſtant tenor, we are preſented with the great irregularities of nature. The burning mountain; the abrupt precipice; the unfathomable cavern; the headlong cataract; and the rapid whirlpool.

If we carry our curioſity a little further, and deſcend to the objects immediately below the ſurface of the globe, we ſhall there find wonders ſtill as amazing. We firſt perceive the earth for the moſt part lying in regular beds or layers, every bed growing thicker in proportion as it lies deeper, and its contents more compact and heavy. We ſhall find, almoſt wherever we make our ſubterranean enquiry, an amazing number of ſhells that belonged to aquatic animals. Here and there, at a diſtance from the ſea, beds of oyſter-ſhells, ſeveral yards thick, and many miles over; ſometimes teſtaceous ſubſtances of various kinds on the tops of mountains, and often in the heart of the hardeſt marble. Theſe, which are dug up by the peaſants, in every country, are regarded with little curioſity; for being ſo very common, they are conſidered as ſubſtances entirely terrene. But it is otherwiſe with the enquirer after nature, who finds them, not only in ſhape but in ſubſtance, every way reſembling thoſe that are found in the ſea; and he, therefore, is at a loſs to account for their removal.

Yet not one part of nature alone, but all her productions and varieties, become the object of the ſpeculative man's enquiry: he takes different views of nature from the inattentive ſpectator; and ſcarce an appearance, how common ſoever, but affords matter for his contemplation: he enquires how and why the ſurface of the earth has thoſe riſings and depreſſions which moſt men call natural; he demands in what manner the mountains were formed, and in what conſiſt their uſes; he aſks from whence ſprings ariſe, and how rivers flow round the convexity of the globe; he enters into an examination of the ebbings and flowings, and the other wonders of the deep; he acquaints himſelf with the irregularities of nature, and endeavours to inveſtigate their cauſes; by which, at leaſt, he will become better verſed in their hiſtory. The internal ſtructure of the globe becomes an object of his curioſity; and, although his enquiries can fathom but a very little way, yet, if poſſeſſed with a ſpirit of theory, his imagination will ſupply the reſt. He will endeavour to account for the ſituation of the marine foſſils that are found in the earth, and for the appearance of the different beds of which it is compoſed. Theſe have been the enquiries that have ſplendidly employed many of the philoſophers of the laſt and preſent age; and, to a certain degree, they muſt be ſerviceable. But the worſt of it is, that, as ſpeculations amuſe the writers more than facts, they may be often carried to an extravagant length; and that time may be ſpent in reaſoning upon nature, which might be more uſefully employed in writing her hiſtory.

Too much ſpeculation in natural hiſtory is certainly wrong; but there is a defect of an oppoſite nature that does much more prejudice; namely, that of ſilencing all enquiry, by alledging the benefits we receive from a thing, inſtead of inveſtigating the cauſe of its production. If we enquire how a mountain came to be formed, ſuch a reaſoner, enumerating its benefits, anſwers, becauſe God knew it would be uſeful. If we demand the cauſe of an earthquake, he finds ſome good produced by it, and alledges that as the cauſe of its exploſion. Thus ſuch an enquirer has ſome ready reaſon for every appearance in nature, which ſerves to ſwell his periods, and give ſplendor to his declamation: every thing about him is, on ſome account or other, declared to be good; and he thinks it preſumption to ſcrutinize its defects, or endeavour to imagine how it might be better. Such writers, and there are many ſuch, add very little to the advancement of knowledge. It is finely remarked by Bacon, that the inveſtigation of final cauſes is a barren ſtudy; and, like a virgin dedicated to the Deity, brings forth nothing. In fact, thoſe men who want to compel every appearance and every irregularity in nature into our ſervice, and expatiate on their benefits, combat that very morality which they would ſeem to promote. God has permitted thouſands of natural evils to exiſt in the world, becauſe it is by their intervention that man is capable of moral evil; and he has permitted that we ſhould be ſubject to moral evil, that we might do ſomething to deſerve eternal happineſs by ſhewing we had rectitude to avoid it.

CHAP. IV.

A Review of the different THEORIES of the EARTH.

HUMAN invention has been exerciſed for ſeveral ages to account for the various irregularities of the earth. While thoſe philoſophers mentioned in the laſt chapter ſee nothing but beauty, ſymmetry, and order; there are others, who look upon the gloomy ſide of nature, enlarge on its defects, and ſeem to conſider the earth, on which they tread, as one ſcene of extenſive deſolation. Beneath its ſurface they obſerve minerals and waters confuſedly jumbled together; its different beds of earth irregularly lying upon each other; mountains riſing from places that once were level; and hills ſinking into vallies; whole regions ſwallowed by the ſea, and others again riſing out of its boſom: all theſe they ſuppoſe to be but a few of the changes that have been wrought in our globe; and they ſend out the imagination to deſcribe its primæval ſtate of beauty.

Of thoſe who have written theories deſcribing the manner of their original formation of the earth, or accounting for its preſent appearances, the moſt celebrated are Burnet, Whiſton, Woodward, and Buffon. As ſpeculation is endleſs, ſo it is not to be wondered that all theſe differ from each other, and give oppoſite accounts of the ſeveral changes, which they ſuppoſe our earth to have undergone. As the ſyſtems of each have had their admirers, it is, in ſome meaſure, incumbent upon the natural hiſtorian to be acquainted, at leaſt, with their outlines; and, indeed, to know what others have even dreamed, in matters of ſcience, is very uſeful, as it may often prevent us from indulging ſemilar deluſions ourſelves, which we ſhould never have adopted, but becauſe we take them to be wholly our own. However, as entering into a detail of theſe theo-

ries, is rather furniſhing an hiſtory of opinions than things, we will endeavour to be as conciſe as poſſible.

The firſt who formed this amuſement of earth-making into ſyſtem, was the celebrated Thomas Burnet, a man of polite learning and rapid imagination. His Sacred Theory, as he calls it, deſcribing the changes which the earth has undergone, or ſhall hereafter undergo, is well known for the warmth with which it is imagined, and the weakneſs with which it is reaſoned, for the elegance of its ſtyle, and the meanneſs of its philoſophy. "The earth," ſays he, "before the deluge, was very differently formed for what it is at preſent: it was at firſt a fluid maſs; a chaos compoſed of various ſubſtances, differing both in denſity and figure: thoſe which were moſt heavy ſunk to the centre, and formed in the middle of our globe an hard ſolid body; thoſe of a lighter nature remained next; and the waters, which were lighter ſtill, ſwam upon its ſurface, and covered the earth on every ſide. The air, and all thoſe fluids which were lighter than water, floated upon this alſo; and in the ſame manner encompaſſed the globe; ſo that between the ſurrounding body of waters, and the circumambient air, there was formed a coat of oil, and other unctuous ſubſtances, lighter than water. However, as the air was ſtill extremely impure, and muſt have carried up with it many of thoſe earthy particles with which it once was intimately blended, it ſoon began to defecate, and to depoſe theſe particles upon the oily ſurface already mentioned, which ſoon uniting, the earth and oil formed that cruſt, which ſoon became an habitable ſurface, giving life to vegetation, and dwelling to animals.

"This imaginary antideluvian abode was very different from what we ſee it at preſent. The earth was light and rich; and formed of a ſubſtance entirely adapted to the feeble ſtate of incipient vegetation: it was an uniform plain, every where covered with verdure; without mountains, without ſeas, or the ſmalleſt inequalities. It had no difference of ſeaſons, for its equator was in the plain of the ecliptic, or, in other words, it turned directly oppoſite to the ſun, ſo that it enjoyed one perpetual and luxuriant ſpring. However, this delightful face of nature did not long continue in the ſame ſtate; for, after a time, it began to crack and open in fiſſures: a circumſtance which always ſucceeds when the ſun exhales the moiſture from rich or marſhy ſituations. The crimes of mankind had been for ſome time preparing to draw down the wrath of Heaven; and they, at length, induced the Deity to defer repairing theſe breaches in nature. Thus the chaſms of the earth every day became wider, and, at length, they penetrated to the great abyſs of waters; and the whole earth, in a manner, fell in. Then enſued a total diſorder in the uniform beauty of the firſt creation, the terrene ſurface of the globe being broken down: as it ſunk the waters guſhed out in its place; the deluge became univerſal; all mankind, except eight perſons, were deſtroyed, and their poſterity condemned to toil upon the ruins of deſolated nature."

It only remains to mention the manner in which he relieves the earth from this univerſal wreck, which would ſeem to be as difficult as even its firſt formation. "Theſe great maſſes of earth falling into the abyſs, drew down with them vaſt quantities alſo of air; and by daſhing againſt each other, and breaking into ſmall parts by the repeated violence of the ſhock, they, at length, left between them large cavities filled with nothing but air. Theſe cavities naturally offered a bed to receive the influent waters; and in proportion as they filled, the face of the earth became once more viſible. The higher parts of its broken ſurface, now become the tops of mountains, were the firſt that appeared; the plains ſoon after came forward, and, at length, the whole globe was delivered from the waters, except the places in the loweſt ſituations; ſo that the ocean and the ſeas are ſtill a part of the ancient abyſs that have not had a place to return. Iſlands and rocks are fragments of the earth's former cruſt; kingdoms and continents are larger maſſes of its broken ſubſtance; and all the inequalities that are to be found on the ſurface of the preſent earth, are owing to the accidental confuſion into which both earth and waters were then thrown."

The next theoriſt was Woodward, who, in his Eſſay towards a Natural Hiſtory of the Earth, which was only deſigned to precede a greater work, has endeavoured to give a more rational account of its appearances; and was, in fact, much better furniſhed for ſuch an undertaking than any of his predeceſſors, being one of the moſt aſſiduous naturaliſts of his time. His little book, therefore, contains many important facts, relative to natural hiſtory, although his ſyſtem may be weak and groundleſs.

He begins by aſſerting that all terrene ſubſtances are diſpoſed in beds of various natures, lying horizontally one over the other, ſomewhat like the coats of an onion; that they are replete with ſhells, and other productions of the ſea: theſe ſhells being found in the deepeſt cavities, and on the tops of the higheſt mountains. From theſe obſervations, which are warrented by experience, he proceeds to obſerve, that theſe ſhells and extraneous foſſils are not productions of the earth, but are all actual remains of thoſe animals which they are known to reſemble; that all the beds of the earth lie under each other, in the order of their ſpecific gravity; and that they are diſpoſed as if they had been left there by ſubſiding waters. All theſe aſſertions he affirms with much earneſtneſs, although daily experience contradicts him in ſome of them; particularly we find layers of ſtone often over the lighteſt ſoils, and the ſofteſt earth under the hardeſt bodies. However, having taken it for granted, that all the layers of the earth are found in the order of their ſpecific gravity, the lighteſt at the top, and the heavieſt next the centre, he conſequently aſſerts, and it will not improbably follow, that all the ſubſtances of which the earth is compoſed, were once in an actual ſtate of diſſolution. This univerſal diſſolution he takes to have happened at the time of the flood. He ſuppoſes that at that time a body of water, which was then in the centre of the earth, uniting with that which was found on the ſurface, ſo far ſeparated the terrene parts as to mix altogether in one fluid maſs; the contents of which afterwards ſinking according to their reſpective gravities, produced the preſent appearances of the earth. Being aware, however, of an objection that foſſile ſubſtances are not found diſſolved, he exempts them from this univerſal diſſolution, and, for that purpoſe, endeavours to ſhew that the parts of animals have a ſtronger coheſion than thoſe of minerals; and that, while even the hardeſt rocks may be diſſolved, bones and ſhells may ſtill continue entire.

So much for Woodward; but of all the ſyſtems which were publiſhed reſpecting the earth's formation, that of Whiſton was moſt applauded, and moſt oppoſed. Nor need we wonder; for being ſupported with all the parade of deep calculation, it awed the ignorant, and produced the approbation of ſuch as would be thought otherwiſe, as it implied a knowledge of abſtruſe learning, to be even thought capable of comprehending what the writer aimed at. In fact, it is not eaſy to diveſt this theory of its mathematical garb; but thoſe who have had leiſure, have found the reſult of our philoſopher's reaſoning to be thus. He ſuppoſes the earth to have been originally a comet; and he conſiders the hiſ-

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tory of the creation, as given us in ſcripture, to have its commencement juſt when it was, by the hand of the Creator, more regularly placed as a planet in our ſolar ſyſtem. Before that time, he ſuppoſes it to have been a globe without beauty or proportion; a world in diſorder; ſubject to all the viciſſitudes which comets endure; ſome of which have been found, at different times, a thouſand times hotter than melted iron; at others, a thouſand times colder than ice. Theſe alternations of heat and cold, continually melting and freezing the ſurface of the earth, he ſuppoſes to have produced, to a certain depth, a chaos entirely reſembling that deſcribed by the poets, ſurrounding the ſolid contents of the earth, which ſtill continued unchanged in the midſt, making a great burning globe of more than two thouſand leagues in diameter. This ſurrounding chaos, however, was far from being ſolid: he reſembles it to a denſe though fluid atmoſphere, compoſed of ſubſtances mingled, agitated, and ſhocked againſt each other; and in this diſorder he deſcribes the earth to have been juſt at the eve of creation.

But upon its orbit's being then changed, when it was more regularly wheeled round the ſun, every thing took its proper place; every part of the ſurrounding fluid then fell into a ſituation, in proportion as it was light or heavy. The middle, or central part, which always remained unchanged, ſtill continued ſo, retaining a part of that heat which it received in its primæval approaches towards the ſun; which he calculates, may continue for about ſix thouſand years. Next to this fell the heavier parts of the chaotic atmoſphere, which ſerve to ſuſtain the lighter: but as in deſcending they could not entirely be ſeparated from many watery parts, with which they were intimately mixed, they drew down a part of theſe alſo with them; and theſe could not mount again after the ſurface of the earth was conſolidated: they, therefore, ſurrounded the heavy firſt deſcending parts, in the ſame manner as theſe ſurround the central globe. Thus the entire body of the earth is compoſed internally of a great burning globe: next which, is placed an heavy terrene ſubſtance, that encompaſſes it; round which alſo is circumfuſed a body of water. Upon this body of water, the cruſt of earth on which we inhabit is placed: ſo that, according to him, the globe is compoſed of a number of coats, or ſhells, one within the other, all of different denſities. The body of the earth being thus formed, the air, which is the lighteſt ſubſtance of all, ſurrounded its ſurface; and the beams of the ſun darting through, produced that light which, we are told, firſt obeyed the Creator's command.

The whole œconomy of the creation being thus adjuſted, it only remained to account for the riſings and depreſſions on the ſurface of the earth, with the other ſeeming irregularities of its preſent appearance. The hills and vallies are conſidered by him as formed by their preſſing upon the internal fluid, which ſuſtains the outward ſhell of earth, with greater or leſs weight: thoſe parts of the earth which are heavieſt, ſink into the ſubjacent fluid more deeply, and become vallies: thoſe that are lighteſt riſe higher upon the earth's ſurface, and are called mountains.

Such was the face of nature before the deluge; the earth was then more fertile and populous than it is at preſent; the life of man and animals was extended to ten times its preſent duration; and all theſe advantages aroſe from the ſuperior heat of the central globe, which ever ſince has been cooling. As its heat was then in full power, the genial principle was alſo much greater than at preſent; vegetation and animal increaſe were carried on with more vigour; and all nature ſeemed teeming with the ſeeds of life. But theſe phyſical advantages were only productive of moral evil; the warmth which invigorated the body encreaſed the paſſions and appetites of the mind; and, as man became more powerful, he grew leſs innocent. It was found neceſſary to puniſh this depravity; and all living creatures were overwhelmed by the deluge in univerſal deſtruction.

This deluge, which ſimple believers are willing to aſcribe to a miracle, philoſophers have long been deſirous to account for by natural cauſes: they have proved that the earth could never ſupply from any reſervoir towards its centre, nor the atmoſphere by any diſcharge from above, ſuch a quantity of water as would cover the ſurface of the globe to a certain depth over the tops of our higheſt mountains. Where, therefore, was all this water to be found? Whiſton has found enough, and more than a ſufficiency, in the tail of a comet; for he ſeems to allot comets a very active part in the great operations of nature.

He calculates, with great ſeeming preciſion, the year, the month, and the day of the week on which this comet (which has paid the earth ſome viſits ſince, though at a kinder diſtance) involved our globe in its tail. The tail may be ſuppoſed to be a vaporous fluid ſubſtance, exhaled from the body of the comet, by the extreme heat of the ſun, and increaſing in proportion as it approached that great luminary. It was in this that our globe was involved at the time of the deluge; and as the earth ſtill acted by its natural attraction, it drew to itſelf all the watery vapours which were in the comet's tail; and the internal waters being alſo at the ſame time let looſe, in a very ſhort ſpace the tops of the higheſt mountains were laid under the deep.

The puniſhment of the deluge being thus completed, and all the guilty deſtroyed, the earth, which had been broken by the eruption of the internal waters, was alſo enlarged by it; ſo that upon the comet's receſs, there was found room ſufficient in the internal abyſs for the receſs of the ſuperfluous waters; whither they all retired, and left the earth uncovered, but in ſome reſpects changed, particularly in its figure, which, from being round, was now become oblate. In this univerſal wreck of nature Noah ſurvived, by a variety of happy cauſes, to re-people the earth, and to give birth to a race of men ſlow in believing ill-imagined theories of the earth.

After ſo many theories of the earth, which had been publiſhed, applauded, anſwered, and forgotten, Mr. Buffon ventured to add one more to the number. This philoſopher was, in every reſpect, better qualified than any of his predeceſſors for ſuch an attempt, being furniſhed with more materials, having a brighter imagination to find new proofs, and a better ſtyle to cloath them in. However, in our opinion, this ſeems the weakeſt part of his admirable work; and we could wiſh, that he had been content with giving us facts inſtead of ſyſtems; that, inſtead of being a reaſoner, he had contented himſelf with being merely an hiſtorian.

He begins his ſyſtem by making a diſtinction between the firſt part of it and the laſt; the one being found only on conjecture, the other depending entirely upon actual obſervation. The latter part of his theory may, therefore, be true, though the former ſhould be found erroneous.

The planets, ſays he, and the earth, among the number, might have been formerly (he only offers this as conjecture) a part of the body of the ſun, and adherent to its ſubſtance. In this ſituation, a comet falling in upon that great body might have given it ſuch a ſhock, and ſo ſhaken its whole frame, that ſome of its particles might have been driven off like ſtreaming ſparkles from red hot iron; and each

of theſe ſtreams of fire, ſmall as they were in compariſon of the ſun, might have been large enough to have made an earth as great, nay many times greater than ours. So that in this manner the planets, together with the globe which we inhabit, might have been driven off from the body of the ſun by an impulſive force: in this manner alſo they would continue to recede from it for ever, were they not drawn back by its ſuperior power of attraction; and thus, by the combination of the two motions, they are wheeled round in circles.

Being in this manner detached at a diſtance from the body of the ſun, the planets, from having been at firſt globes of liquid fire, gradually became cool. The earth alſo having been impelled obliquely forward, received a rotatory motion upon its axis at the very inſtant of its formation; and this motion being greateſt at the equator, the parts there acting againſt the force of gravity, they muſt have ſwollen out, and given the earth an oblate or flatted figure.

As to its internal ſubſtance, our globe having once belonged to the ſun, it continues to be an uniform maſs of melted matter, very probably vitrified in its primæval fuſion. But its ſurface is very differently compoſed. Having been in the beginning heated to a degree equal to, if not greater, than what comets are found to ſuſtain, like them it had an atmoſphere of vapours floating round it, and which cooling by degrees, condenſed and ſubſided upon its ſurface. Theſe vapours formed, according to their different denſities, the earth, the water, and the air; the heavier parts falling firſt, and the lighter remaining ſtill ſuſpended.

Thus far our philoſopher is, at leaſt, as much a ſyſtem-maker as Whiſton or Burnet; and, indeed, he fights his way with great perſeverance and ingenuity through a thouſand objections that naturally ariſe. Having, at laſt, got upon the earth, he ſuppoſes himſelf on firmer ground, and goes forward with greater ſecurity. Turning his attention to the preſent appearance of things upon this globe, he pronounces from the view that the whole earth was at firſt under water. This water he ſuppoſes to have been the lighter parts of its former evaporation, which, while the earthy particles ſunk downwards by their natural gravity, floated on the ſurface, and covered it for a conſiderable ſpace of time.

"The ſurface of the earth," ſays he, "muſt have been in the beginning much leſs ſolid than it is at preſent; and, conſequently, the ſame cauſes, which at this day produce but very ſlight changes, muſt then, upon ſo complying a ſubſtance, have had very conſiderable effects. We have no reaſon to doubt but that it was then covered with the waters of the ſea; and that thoſe waters were above the tops of our higheſt mountains, ſince, even in ſuch elevated ſituations, we find ſhells and other marine productions in very great abundance. It appears alſo that the ſea continued for a conſiderable time upon the face of the earth: for as theſe layers of ſhells are found ſo very frequent at ſuch great depths, and in ſuch prodigious quantities, it ſeems impoſſible for ſuch numbers to have been ſupported all alive at one time; ſo that they muſt have been brought there by ſucceſſive depoſitions. Theſe ſhells alſo are found in the bodies of the hardeſt rocks, where they could not have been depoſited, all at once, at the time of the deluge, or at any ſuch inſtant revolution; ſince that would be to ſuppoſe, that all the rocks in which they are found, were, at that inſtant, in a ſtate of diſſolution, which would be abſurd to aſſert. The ſea, therefore, depoſited them whereſoever they are now to be found, and that by ſlow and ſucceſſive degrees.

"It will appear, alſo, that the ſea covered the whole earth, from the appearance of its layers, which lying regularly one above the other, ſeem all to reſemble the ſediment formed at different times by the ocean. Hence, by the irregular force of its waves, and its currents driving the bottom into ſand-banks, mountains muſt have been gradually formed within this univerſal covering of waters; and theſe ſucceſſively raiſing their heads above its ſurface, muſt, in time, have formed the higheſt ridges of mountains upon land, together with continents, iſlands and low grounds, all in their turns. This opinion will receive additional weight by conſidering, that in thoſe parts of the earth where the power of the ocean is greateſt, the inequalities on the ſurface of the earth are higheſt: the ocean's power is greateſt at the equator, where its winds and tides are moſt conſtant; and, in fact, the mountains at the equator are found to be higher than in any other part of the world. The ſea, therefore, has produced the principal changes in our earth: rivers, volcanoes, earthquakes, ſtorms, and rain, having made but ſlight alterations, and only ſuch as have affected the globe to very inconſiderable depths."

This is but a very ſlight ſketch of Mr. Buffon's Theory of the Earth; a theory which he has much more powerfully ſupported, than happily invented; and it would be needleſs to take up the reader's time from the purſuit of truth in the diſcuſſion of plauſibilities. In fact, a thouſand queſtions might be aſked this moſt ingenious philoſopher, which he would not find it eaſy to anſwer; but ſuch is the lot of humanity, that a ſingle Goth can in one day deſtroy the fabric which Cæſars were employed an age in erecting. We might aſk, how mountains, which are compoſed of the moſt compact and ponderous ſubſtances, ſhould be the firſt whoſe parts the ſea began to remove? We might aſk, how foſſil-wood is found deeper even then ſhells? which argues, that trees grew upon the places he ſuppoſes once to have been covered with the ocean. But we hope this excellent man is better employed than to think of gratifying the petulance of incredulity, by anſwering endleſs objections.

CHAP. V.

Containing the NATURAL HISTORY of FOSSIL-SHELLS, and other extraneous FOSSILS.

WE may affirm of Mr. Buffon, that which has been ſaid of the chymiſts of old: though he may have failed in attaining his principal aim, of eſtabliſhing a theory, yet he has brought together ſuch a multitude of facts relative to the hiſtory of the earth, and the nature of its foſſil productions, that curioſity finds ample compenſation even while it feels the want of conviction.

Before, therefore, we enter upon the deſcription of thoſe parts of the earth, which ſeem more naturally to fall within the ſubject, it will not be improper to give a ſhort hiſtory of thoſe animal productions that are found in ſuch quantities, either upon its ſurface, or at different depths below it. They demand our curioſity, and, indeed, there is nothing in natural hiſtory that has afforded more ſcope for doubt, conjecture, and ſpeculation. Whatever depths of the earth we examine, or at whatever diſtance within land we ſeek, we moſt commonly find a number of foſſil-ſhells, which being compared with others from the ſea, of known kinds, are found to be exactly of a ſimilar ſhape and nature. They are found at the very bottom of quarries and mines, in the retired and inward parts of the moſt firm and ſolid rocks, upon the tops of even the higheſt hills and mountains, as well as in the valleys and plains: and this

Class IX. Fossil Shells.

PECTEN

OSTRACITES

CONCHA Margaritifera.

TIBULLUS Marinus.

BUCARDITÆ

DENTALIA

CYLINDRI

SYRINGOIDES Lapis.

TROCHII

COCHLEÆ

NERITÆ

BUCCINA

NAUTILI

CONCHÆ Anomiæ.

Ammonitæ or SNAKE Stones.

ORTHOCERATITES

GRYPHITES

ECHINITÆ

Class X. Fossil Bodies, once parts of Animals.

BELEMNITÆ

JUDAICUS

ACULEI Echinorum.

ENTROCHUS

TROCHITÆ

APPENDICULÆ Asteriarum.

ASTEROPODIUM cum Asteria.

Asteriæ or STAR Stones

ASTEROPODIUM

London: Published by Alex.r Hogg, at the Kings Arms, N.o 16, Paternoster Row.

Eastgate sculp.

this not in one country alone, but in all places where there is any digging for marble, chalk, or any other terreſtrial matters, that are ſo compact as to fence off the external injuries of the air, and thus preſerve theſe ſhells from decay.

Theſe marine ſubſtances, ſo commonly diffuſed, and ſo generally to be met with, were for a long time conſidered by philoſophers, as productions, not of the ſea, but of the earth. "As we find that ſpars," ſaid they, "always ſhoot into peculiar ſhapes, ſo theſe ſeeming ſnails, cockles, and muſcle-ſhells, are only ſportive forms that nature aſſumes amongſt others of its mineral varieties: they have the ſhape of fiſh, indeed, but they have always been terreſtrial ſubſtances."

With this plauſible ſolution mankind were for a long time content; but upon cloſer enquiry, they were obliged to alter their opinion. It was found that theſe ſhells had, in every reſpect, the properties of animal and not of mineral nature. They were found exactly of the ſame weight with their fellow ſhells upon ſhore. They anſwered all the chemical trials in the ſame manner as ſea ſhells do. Their parts, when diſſolved, had the ſame appearance to view, the ſame ſmell and taſte. They had the ſame effects in medicine when inwardly adminiſtered; and, in a word, were ſo exactly conformable to marine bodies, that they had all the accidental concretions growing to them, (ſuch as pearls, corals, and ſmaller ſhells) which are found in ſhells juſt gathered on the ſhore. They were, therefore, from theſe conſiderations, given back to the ſea; but the wonder was, how to account for their coming ſo far from their own natural element upon land.

As this naturally gave riſe to many conjectures, it is not to be wondered that ſome among them have been very extraordinary. An Italian, quoted by Mr. Buffon, ſuppoſes them to have been depoſited in the earth at the time of the cruſades, by the pilgrims who returned from Jeruſalem: who gathering them upon the ſea ſhore, in their return carried them to their different places of habitation. But this conjecturer ſeems to have but a very inadequate idea of their numbers. At Touraine, in France, more than an hundred miles from the ſea, there is a plain of about nine leagues long, and as many broad, from whence the peaſants of the country ſupply themſelves with marle for manuring their lands. They ſeldom dig deeper than twenty feet, and the whole plain is compoſed of the ſame materials, which are ſhells of various kinds, without the ſmalleſt portion of earth between them. Here then, is a large ſpace, in which are depoſited millions of tons of ſhells, that pilgrims could not have collected, though their whole employment had been nothing elſe. England is furniſhed with its beds, which though not quite ſo extenſive, yet are equally wonderful. "Near Reading in Berkſhire, for many ſucceeding generations, a continued body of oyſter-ſhells has been found through the whole circumference of five or ſix acres of ground. The foundation of theſe ſhells is an hard rocky chalk; and above this chalk, the oyſter-ſhells lie in a bed of green ſand, upon a level, as nigh as can poſſible be judged, and about two feet thickneſs." Theſe ſhells are in their natural ſtate, but they were found alſo petrified, and almoſt in equal abundance in all the Alpine rocks, in the Pyrenees, on the hills of France, England, and Flanders. Even in all quarries from whence marble is dug, if the rocks be ſplit perpendicularly downwards, petrified ſhells, and other marine ſubſtances, will be plainly diſcerned.

"About a quarter of a mile from the river Medway, in the county of Kent, after the taking off the coping of a piece of ground there, the workmen came to a blue marble, which continued for three feet and a half deep, or more, and then beneath appeared an hard floor or pavement, compoſed of petrified ſhells crowded cloſely together. This layer was about an inch deep, and ſeveral yards over; and it could be walked upon as upon a beach. Theſe ſtones, of which it was compoſed, (the deſcriber ſuppoſes them to have always been ſtones) were either wreathed as ſnails, or bivalvular like cockles. The wreathed kinds were about the ſize of an hazle-nut, and were filled with a ſtony ſubſtance of the colour of marle; and they themſelves, alſo, till they were waſhed, were of the ſame colour; but when cleaned they appear of the colour of bezoar, and of the ſame poliſh. After boiling in water they became whitiſh, and left a chalkineſs upon the fingers."

In ſeveral parts of Aſia and Africa, travellers have obſerved theſe ſhells in great abundance. In the mountains of Caſtravan, which lie above the city Barut, they quarry out a white ſtone, every part of which contains petrified fiſhes in great numbers, and of ſurpriſing diverſity. They alſo ſeem to continue in ſuch preſervation, that their fins, ſcales, and all the minuteſt diſtinctions of their make, can be perfectly diſcerned.

From all theſe inſtances we may conclude, that foſſils are very numerous; and, indeed, independent of their ſituation, they afford no ſmall entertainment to obſerve them as preſerved in the cabinets of the curious. The varieties of their kinds is aſtoniſhing. Moſt of the ſea ſhells which are known, and many others to which we are entirely ſtrangers, are to be ſeen either in their natural ſtate, or in various degrees of petrefaction. In the place of ſome we have mere ſpar, or ſtone, exactly expreſſing all the lineaments of animals, as having been wholly formed from them. For it has happened that the ſhells diſſolving by very ſlow degrees, and the matter having nicely and exactly filled all the cavities within, this matter, after the ſhells have periſhed, has preſerved exactly and regularly the whole print of their internal ſurface. Of theſe there are various kinds found in our pits; many of them reſembling thoſe of our own ſhores; and many others that are only to be found on the coaſts of other countries. There are ſome ſhells reſembling thoſe that are never ſtranded upon our coaſts, but always remain in the deep: and many more there are which we can aſſimilate with no ſhells known amongſt us. But we find not only ſhells in our pits, but alſo fiſhes and corals in great abundance; together with almoſt every ſort of marine production.

It is extraordinary enough, however, that the common red coral, though ſo very frequent at ſea, is ſcarce ſeen in the foſſil world; nor is there any account of its having ever been met with. But to compenſate for this, there are all the kinds of the white coral now known; and many other kinds of that ſubſtance with which we are unacquainted. Of animals there are various parts; the vertebræ of whales, and the mouths of leſſer fiſhes; theſe, with teeth alſo of various kinds, are found in the cabinets of the curious; where they receive long Greek names, which it is neither the intention nor the province of this work to enumerate. Indeed, few readers would think themſelves much improved, ſhould we proceed with enumerating the various claſſes of the Conicthyodonts, Polyleptoginglimi, or the Orthoceratites. Theſe names, which mean no great matter when they are explained, may ſerve to guide in the furniſhing a cabinet; but they are of very little ſervice in furniſhing the page of inſtructive hiſtory.

From all theſe inſtances we ſee in what abundance petrefactions are to be found; and, indeed,

Mr.

Mr. Buffon, has not been ſparing in the variety of his quotations, concerning the places where they are moſtly to be found. However, we are ſurpriſed that he ſhould have omitted the mention of one, which, in ſome meaſure, more than any of the reſt, would have ſerved to ſtrengthen his theory. We are informed by almoſt every traveller, that has deſcribed the pyramids of Egypt, that one of them is entirely built of a kind of free-ſtone, in which theſe petrified ſhells are found in great abundance. This being the caſe, it may be conjectured, as we have accounts of theſe pyramids among the earlieſt records of mankind, and of their being built ſo long before the age of Herodotus, who lived but fifteen hundred years after the flood, that even the Egyptian prieſts could tell neither the time nor the cauſe of their erection; therefore it may be conjectured that they were erected but a ſhort time after the flood. It is not very likely, therefore, that the marine ſubſtances found in one of them, had time to be formed into a part of the ſolid ſtone, either during the deluge, or immediately after it; and, conſequently, their petrefaction muſt have been before that period. And this is the opinion Mr. Buffon has ſo ſtrenuouſly endeavoured to maintain; having given ſpecious reaſons to prove, that ſuch ſhells were laid in the beds where they are now found, not only before the deluge, but even antecedent to the formation of man, at the time when the whole earth, as he ſuppoſes, was buried beneath a covering of waters.

But while there are many reaſons to perſuade us that theſe extraneous foſſils have been depoſited by the ſea, there is one fact that will abundantly ſerve to convince us that the earth was habitable, if not inhabited, before theſe marine ſubſtances came to be thus depoſited; for we find foſſil-trees, which no doubt once grew upon the earth, as deep, and as much in the body of ſolid rocks, as theſe ſhells are found to be. Some of theſe fallen trees alſo have lain at laſt as long, if not longer, in the earth, than the ſhells, as they have been found ſunk deep in a marly ſubſtance, compoſed of decayed ſhells, and other marine productions. Mr. Buffon has proved that foſſil-ſhells could not have been depoſited in ſuch quantities all at once by the flood; and we think, from the above inſtance, it is pretty plain, that howſoever they were depoſited, the earth was covered with trees before their depoſition; and, conſequently, that the ſea could not have made a very permanent ſtay. How then ſhall we account for theſe extraordinary appearances in nature? A ſuſpenſion of all aſſent is certainly the firſt, although the moſt mortifying conduct. Were we to offer a conjecture (and all that has been ſaid upon this ſubject is but conjecture) inſtead of ſuppoſing them to be the remains of animals belonging to the ſea, we would conſider them rather as bred in the numerous freſh-water lakes that, in primæval times, covered the face of uncultivated nature. Some of theſe ſhells we know to belong to freſh waters: ſome can be aſſimilated to none of the marine ſhells now known; why, therefore, may we not as well aſcribe the production of all to freſh waters, where we do not find them, as we do that of the latter to the ſea only, where we never find them? We know that lakes, and lands alſo, have produced animals that are now no longer exiſting; why, therefore, might not theſe foſſil productions be among the number? We allow that this is making a very harſh ſuppoſition; but we cannot avoid thinking, that it is not attended with ſo many embarraſſments as ſome of the former; and that it is much eaſier to believe that theſe ſhells were bred in freſh water, than that the ſea had for a long time covered the tops of the higheſt mountains.

CHAP. VI.

NATURAL HISTORY of the internal Structure of the EARTH.

HAVING, in ſome meaſure, got free from the regions of conjecture, let us now proceed to a deſcription of the earth as we find it by examination, and obſerve its internal compoſition, as far as it has been the ſubject of experience, or expoſed to human enquiry. Theſe enquiries, indeed, have been carried but to a very little depth below its ſurface, and even in that diſquiſition men have been conducted more by motives of avarice than of curioſity. The deepeſt mine, which is that at Cotteberg in Hungary, reaches not more than three thouſand feet deep; but what proportion does that bear to the depth of the terreſtrial globe, down to the centre, which is above four thouſand miles? All, therefore, that has been ſaid of the earth, to a deeper degree, is merely fabulous or conjectural: we may ſuppoſe with Buffon, that it is a globe of glaſs; with Whiſton, a ſphere of heated iron; with Burnet, a great maſs of waters; and with Kircher, one dreadful volcano; but let us, at the ſame time, ſhew our conſciouſneſs, that all theſe are but ſuppoſitions.

Upon examining the earth, where it has been opened to any depth, the firſt thing that occurs, is the different layers or beds of which it is compoſed; theſe all lying horizontally one over the other like the leaves of a book, and each of them compoſed of materials that increaſe in weight in proportion as they lie deeper. This is, in general, the diſpoſition of the different materials where the earth ſeems to have remained unmoleſted; but this order is frequently inverted; and we cannot tell whether from its original formation, or from accidental cauſes. Of different ſubſtances, thus diſpoſed, the far greateſt part of our globe conſiſts, from its ſurface downwards to the greateſt depths we ever dig or mine.

The firſt layer moſt commonly found at the ſurface, is that light coat of blackiſh mould, which is called, by ſome, garden earth. With this the earth is every where inveſted, unleſs it be waſhed off by rains, or removed by ſome other external violence. This ſeems to have been formed from animal and vegetable bodies decaying, and thus turning into its ſubſtance. It alſo ſerves again as a ſtore-houſe, from whence animal and vegetable nature are renewed; and thus are all vital bleſſings continued with unceaſing circulation. This earth, however, is not to be ſuppoſed entirely pure, but is mixed with much ſtony and gravelly matter, from the layers lying immediately beneath it. It generally happens, that the ſoil is fertile in proportion to the quantity that this putrified mould bears to the gravelly mixture; and as the former predominates, ſo far is the vegetation upon it more luxuriant. It is this external covering that ſupplies man with all the true riches he enjoys. He may bring up gold and jewels from greater depths; but they are merely the toys of a capricious being, things upon which he has placed an imaginary value, and for which fools alone part with the more ſubſtantial bleſſings of life. It is this earth, ſays Pliny, that, like a kind mother, receives us at our birth, and ſuſtains us when born. It is this alone, of all the elements around us, that is never found an enemy to man. The body of waters deluge him with rains, oppreſs him with hail, and drown him with inundations. The air ruſhes in ſtorms, prepares the tempeſt, or lights up the volcano; but the earth, gentle and indulgent, ever ſubſervient to the wants of man, ſpreads his walks with flowers, and his table with plenty;

plenty; returns with intereſt every good committed to her care; and, though ſhe produces the poiſon, ſhe ſtill ſupplies the antidote; though conſtantly teized more to furniſh the luxuries of man than his neceſſities, yet, even to the laſt, ſhe continues her kind indulgence, and, when life is over, ſhe piouſly covers his remains in her boſom.

This external and fruitful layer which covers the earth, is, as was ſaid, in a ſtate of continual change. Vegetables, which are naturally fixed and rooted to the ſame place, receive their adventitious nouriſhment from the ſurrounding earth and water: animals, which change from place to place, are ſupported by theſe, or by each other. Both, however, having for a time enjoyed a life adapted to their nature, give back to the earth thoſe ſpoils, which they had borrowed for a very ſhort ſpace, yet ſtill to be quickened again into freſh exiſtence. But the depoſits they make are of very diſſimilar kinds, and the earth is very differently enriched by their continuance. Thoſe countries that have for a long time ſupported men and other animals, having been obſerved to become every day more barren, while, on the contrary, thoſe deſolate places, in which vegetables only are abundantly produced, are known to be poſſeſſed of amazing fertility. "In regions which are uninhabited," ſays Mr. Buffon, "where the foreſts are not cut down, and where animals do not feed upon the plants, the bed of vegetable earth is conſtantly increaſing. In all woods, and even in thoſe often cut, there is a layer of earth of ſix or eight inches thick, which has been formed by the leaves, branches and bark, which fall and rot upon the ground. It has frequently been obſerved on a Roman way which croſſes Burgundy for a long extent, that there is a bed of black earth, of more than a foot thick, gathered over the ſtony pavement, on which ſeveral trees, of a very conſiderable ſize, are ſupported. This is found to be nothing elſe than an earth formed by decayed leaves and branches, which have been converted by time into a black ſoil. Now as vegetables draw much more of their nouriſhment from the air and water than they do from the earth, it muſt follow, that in rotting upon the ground, they muſt give more to the ſoil than they have taken from it. Hence, therefore, in woods kept a long time without cutting, the ſoil below increaſes to a conſiderable depth; and ſuch we actually find the ſoil in thoſe American wilds where the foreſts have been undiſturbed for ages. But it is otherwiſe where men and animals have long ſubſiſted; for as they make a conſiderable conſumption of wood and plants, both for firing and other uſes, they take more from the earth than they return to it: it follows, therefore, that the bed of vegetable earth, in an inhabited country, muſt be always diminiſhing; and muſt, at length, reſemble the ſoil of Arabia Petrea, and other provinces of the Eaſt, which having been long inhabited, are now become plains of ſalt and ſand; the fixed ſalt always remaining while the other volatile parts have flown away."

If from this external ſurface we deſcend deeper, and view the earth cut perpendicularly downwards, either in the banks of great rivers, or ſteepy ſea ſhores; or, going ſtill deeper, if we obſerve it in quarries or mines, we ſhall find its layers regularly diſpoſed in their proper order. We muſt not expect, however, to find them of the ſame kind or thickneſs in every place, as they differ in different ſoils and ſituations. Sometimes marle is ſeen to be over ſand, and ſometimes under it. The moſt common diſpoſition is, that under the firſt earth is found gravel or ſand, then clay or marle, then chalk or coal, marbles, ores, ſands, gravels; and thus an alternation of theſe ſubſtances, each growing more denſe as it ſinks deeper. The clay, for inſtance, found at the depth of an hundred feet, is uſually more heavy than that found not far from the ſurface. In a well which was dug at Amſterdam, to the depth of two hundred and thirty feet, the following ſubſtances were found in ſucceſſion: ſeven feet of vegetable earth, nine of turf, nine of ſoft clay, eight of ſand, four of earth, ten of clay, four of earth, ten of ſand, two of clay, four of white ſand, one of ſoft earth, fourteen of ſand, eight of clay mixed with ſand, four of ſea-ſand mixed with ſhells, then an hundred and two feet of ſoft clay, and then thirty-one feet of ſand.

In a well dug at Marly, to the depth of an hundred feet, Mr. Buffon gives us a ſtill more exact enumeration of its layers of earth. Thirteen of a reddiſh gravel, two of gravel minged with a vitrifiable ſand, three of mud or ſlime, two of marle, four of marly ſtone, five of marle in duſt mixed with vitrifiable ſand, ſix of very fine vitrifiable ſand, three of earthy marle, three of hard marle, one of gravel, one of eglantine, a ſtone of the hardneſs and grain of marble, one of gravelly marle, one of ſtony marle, one of a coarſer kind of ſtony marle, two of a coarſer kind ſtill, one of vitrifiable ſand mixed with foſſil ſhells, two of fine gravel, three of ſtony marle, one of coarſe powdered marle, one of ſtone, calcinable like marble, three of grey ſand, two of white ſand, one of red ſand ſtreaked with white, eight of grey ſand with ſhells, three of very fine ſand, three of a hard grey ſtone, four of red ſand ſtreaked with white, three of white ſand, and fifteen of a reddiſh vitrifiable ſand.

In this manner the earth is every where found in beds over beds; and, what is ſtill remarkable, each of them, as far as it extends, always maintains exactly the ſame thickneſs. It is found alſo, that, as we proceed to conſiderable depths, every layer grows thicker. Thus in the adduced inſtances we might have obſerved, that the laſt layer was fifteen feet thick, while moſt of the others were not above eight; and this might have gone much deeper, for ought we can tell, as before they got through it the workmen ceaſed digging.

Theſe layers are ſometimes very extenſive, and often are found to cover a ſpace of ſome leagues in circumference. But it muſt not be ſuppoſed that they are uniformly continued over the whole globe without any interruption: on the contrary, they are ever, at ſmall intervals, cracked through as it were by perpendicular fiſſures; the earth reſembling, in this reſpect, the muddy bottom of a pond, from whence the water has been dried off by the ſun, and thus gaping in ſeveral chinks, which deſcend in a direction perpendicular to its ſurface. Theſe fiſſures are many times found empty, but oftener cloſed up with adventitious ſubſtances, that the rain, or ſome other accidental cauſes, have conveyed to fill their cavities. Their openings are not leſs different than their contents, ſome being not above half an inch wide, ſome a foot, and ſome ſeveral hundred yards aſunder; which laſt form thoſe dreadful chaſms that are to be found in the Alps, at the edge of which the traveller ſtands, dreading to look down at the immeaſurable gulph below. Theſe amazing cleſts are well known to ſuch as have paſt theſe mountains, where a chaſm frequently preſents itſelf ſeveral hundred feet deep, and as many over, at the edge of which the way lies. It often happens alſo, that the road leads along the bottom, and then the ſpectator obſerves on each ſide frightful precipices ſeveral hundred yards above him; the ſides of which correſpond ſo exactly with each other, that they evidently ſeem torn aſunder.

But theſe chaſms to be found in the Alps, are nothing to what Ovalle tells us are to be ſeen in the

Andes. Theſe amazing mountains, in compariſon of which the former are but little hills, have their fiſſures in proportion to their greatneſs. In ſome places they are a mile wide, and deep in proportion; and there are ſome others, that running under ground, in extent reſemble a province.

Of this kind alſo is that cavern called Elden-hole, in Derbyſhire; which, Dr. Plot tells us, was ſounded by a line of eight and twenty hundred feet, without finding the bottom, or meeting with water: and yet the mouth at the top is not above forty yards over. This immeaſureable caverns runs perpendicularly downward; and the ſides of it ſeem to tally ſo plainly as to ſhew that they once were united. Thoſe who come to viſit the place, generally procure ſtones to be thrown into its mouth; and theſe are heard for ſeveral minutes, falling and ſtriking againſt the ſides of the cavern, producing a ſound that reſembles diſtant thunder, dying away as the ſtone goes deeper.

Of this kind alſo is that dreadful cavern deſcribed by Ælian; his account of which the reader may not have met with. "In the country of the Arrian Indians, is to be ſeen an amazing chaſm, which is called, The Gulph of Pluto. The depth, and the receſſes of this horrid place, are as extenſive as they are unknown. Neither the natives, nor the curious who viſit it, are able to tell how it firſt was made, or to what depths it deſcends. The Indians continually drive thither great multitudes of animals, more than three thouſand at a time, of different kinds, ſheep, horſes, and goats; and, with an abſurd ſuperſtition, force them into the cavity, from whence they never return. Their ſeveral ſounds, however, are heard as they deſcend; the bleating of ſheep, the lowing of oxen, and the neighing of horſes, iſſuing up to the mouth of the cavern. Nor do theſe ſounds ceaſe, as the place is continually furniſhed with a freſh ſupply."

There are many more of theſe dreadful perpendicular fiſſures in different parts of the earth; with accounts of which Kircher, Gaſſarellus, and others, who have given hiſtories of the wonders of the ſubterranean world, abundantly ſupply us. The generality of readers, however, will conſider them with leſs aſtoniſhment, when they are informed of their being common all over the earth: that in every field, in every quarry, theſe perpendicular fiſſures are to be found; either ſtill gaping, or filled with matter that has accidentally cloſed their interſtices. The inattentive ſpectator neglects the enquiry, but their being common is partly the cauſe that excites the philoſopher's attention to them: the irregularities of nature he is often content to let paſs unexamined; but when a conſtant and a common appearance preſents itſelf, every return of the object is a freſh call to his curioſity; and the chink in the next quarry becomes as great a matter of wonder as the chaſm in Elden-hole. Philoſophers have long, therefore, endeavoured to find out the cauſe of theſe perpendicular fiſſures, which our own countrymen, Woodward and Ray, were the firſt that found to be ſo common and univerſal. Mr. Buffon ſuppoſes them to be cracks made by the ſun, in drying up the earth immediately after its emerſion from the deep. The heat of the ſun is very probably a principal cauſe; but it is not right to aſcribe to one only, what we find may be the reſult of many. Earthquakes, ſevere froſts, burſting waters, and ſtorms tearing up the roots of trees, have, in our own times, produced them: and to this variety of cauſes we muſt, at preſent, be content to aſſign thoſe that have happened before we had opportunities for obſervation.

CHAP. VII.

Of CAVES and Subterraneous PASSAGES that ſink, but not perpendicularly, into the Earth.

WHEN we ſurvey the ſubterrenean wonders of the globe, beſides thoſe fiſſures that deſcend perpendicularly, we frequently find others that deſcend but a little way, and then ſpread themſelves often to a great extend below the ſurface. Many of theſe caverns, it muſt be confeſſed, may be the production of art and human induſtry; retreats made to protect the oppreſſed, or ſhelter the ſpoiler. The famous labyrinth of Candia, for inſtance, is ſuppoſed to be entirely the work of art. Mr. Tournefort aſſures us, that it bears the impreſſion of human induſtry, and that great pains have been beſtowed upon its formation. The ſtone-quarry of Maeſtricht is evidently made by labour: carts enter at its mouth, and load within, then return and diſcharge their freight into boats that lie on the brink of the river Maeſe. This quarry is ſo large, that forty thouſand people may take ſhelter in it: and it in general ſerves for this purpoſe, when armies march that way; becoming then an impregnable retreat to the people that live thereabout. Nothing can be more beautiful than this cavern, when lighted up with torches; for there are thouſands of ſquare pillars, in large level walks, about twenty feet high; and all wrought with much neatneſs and regularity. In this vaſt grotto there is very little rubbiſh; which ſhews both the goodneſs of the ſtone, and the careſulneſs of the workmen. To add to its beauty, there alſo are, in various parts of it, little pools of water, for the convenience of the men and cattle. It is remarkable alſo, that no droppings are ſeen to fall from the roof, nor are the walks any way wet under foot, except in caſes of great rains, where the water gets in by the air ſhafts. The Salt-mines in Poland are ſtill more ſpacious than theſe. Some of the catacombs, both in Egypt and Italy, are ſaid to be very extenſive. But no part of the world has a greater number of artificial caverns than Spain, which were made to ſerve as retreats to the Chriſtians, againſt the fury of the Moors, when the latter conquered that country. However, an account of the works of art does not properly belong to a natural hiſtory. It will be ſufficient to obſerve, that though caverns be found in every country, far the greateſt part of them have been faſhioned by the hand of Nature only. Their ſize is found beyond the power of man to have effected; and their forms but ill adapted to the conveniences of an human habitation. In ſome places, indeed, we find mankind ſtill make uſe of them as houſes; particularly in thoſe countries where the climate is very ſevere; but in general they are deſerted by every race of meaner animals, except the bat: theſe nocturnal ſolitary creatures are uſually the only inhabitants; and theſe only in ſuch whoſe deſcent is ſloping, or, at leaſt, not directly perpendicular.

There is ſcarce a country in the world without its natural caverns; and many new ones are diſcovered every day. Of thoſe in England, Oakey-hole, the Devil's-hole, and Penpark-hole, have been often deſcribed. The former, which lies on the ſouth ſide of Mendip-hills, within a mile of the town of Wells, is much reſorted to by travellers. To conceive a juſt idea of this, we muſt imagine a precipice of more than an hundred yards high, on the ſide of a mountain which ſhelves away a mile above it. In this is an opening not very large, into which you enter, going along upon a rocky uneven pavement, ſometimes aſcending, and ſometimes deſcending. The roof of it, as you advance, grows

grows higher; and, in ſome places, is fifty feet from the floor. In ſome places, however, it is ſo low that a man muſt ſtoop to paſs. It extends itſelf, in length, about two hundred yards; and from every part of the roof, and the floor, there are formed ſparry concretions of various figures, that by ſtrong imaginations have been likened to men, lions, and organs. At the fartheſt part of this cavern riſes a ſtream of water, well ſtored with fiſh, large enough to turn a mill, and which diſcharges itſelf near the entrance.

Penpark-hole, in Glouceſterſhire, is almoſt as remarkable as the former. Captain Sturmey deſcended into this by a rope, twenty-five fathoms perpendicular, and at the bottom found a very large vault in the ſhape of an horſe-ſhoe. The floors conſiſted of a kind of white ſtone enamelled with lead ore, and the pendent rocks were glazed with ſpar. Walking forward on this ſtony pavement, for ſome time, he came to a great river, twenty fathoms broad, and eight fathoms deep; and having been informed that it ebbed and flowed with the ſea, he remained in his gloomy abode for five hours, to make an exact obſervation. He did not find, however, any alteration whatſoever in its appearance. But his curioſity was ill requited; for it coſt this unfortunate gentleman his life: immediately after his return, he was ſeized with an unuſual and violent head-ach, which threw him into a fever, of which he died ſoon after.

But of all the ſubterraneous caverns now known, the grotto of Antiparos is the moſt remarkable, as well for its extent, as for the beauty of its ſparry incruſtations. This celebrated cavern was firſt diſcovered by one Magni, an Italian traveller, about an hundred years ago, at Antiparos, an inconſiderable iſland of the Archipelago. The account he gives of it is long and inflated, but upon the whole amuſing. "Having been informed," ſays he, "by the natives of Paros, that in the little iſland of Antiparos, which lies about two miles from the former, of a gigantic ſtatue that was to be ſeen at the mouth of a cavern in that place, it was reſolved that we (the French conſul and himſelf) ſhould pay it a viſit. In purſuance of this reſolution, after we had landed on the iſland, and walked about four miles through the midſt of beautiful plains, and ſloping woodlands, we at length came to a little hill, on the ſide of which yawned a moſt horrid cavern, that with its gloom at firſt ſtruck us with terror, and almoſt repreſſed curioſity. Recovering the firſt ſurprize, however, we entered boldly; and had not proceeded above twenty paces, when the ſuppoſed ſtatue of the giant preſented itſelf to our view. We quickly perceived, that what the ignorant natives had been terrified at as a giant, was nothing more than a ſparry concretion, formed by the water dropping from the roof of the cave, and by degrees hardening into a figure that their fears had formed into a monſter. Incited by this extraordinary appearance, we were induced to proceed ſtill farther, in queſt of new adventures in this ſubterranean abode. As we proceeded, new wonders offered themſelves; the ſpars, formed into trees and ſhrubs, preſented a kind of petrified grove; ſome white, ſome green; and all receding in due perſpective. They ſtruck us with the more amazement, as we knew them to be mere productions of Nature, who, hitherto in ſolitude, had, in her playful moments, dreſſed the ſcene, as if for her own amuſement.

"But we had as yet ſeen but a few of the wonders of the place; and we are introduced only into the portico of this amazing temple. In one corner of this half illuminated receſs, there appeared an opening of about three feet wide, which ſeemed to lead to a place totally dark, and that one of the natives aſſured us contained nothing more than a reſervoir of water. Upon this we tried, by throwing down ſome ſtones, which rumbling along the ſides of the deſcent for ſome time, the ſound ſeemed at laſt quaſhed in a bed of water. In order, however, to be more certain, we ſent in a Levantine mariner, who, by the promiſe of a good reward, with a flambeaux in his hand, ventured into this narrow aperture. After continuing within it for about a quarter of an hour, he returned, carrying ſome beautiful pieces of white ſpar in his hand, which art could neither imitate nor equal. Upon being informed by him that the place was full of theſe beautiful incruſtations, I ventured in once more with him, for about fifty paces, anxiouſly and cautiouſly deſcending by a ſteep and dangerous way. Finding, however, that we came to a precipice which led into a ſpacious amphitheatre, if I may ſo call it, ſtill deeper than any other part, we returned, and being provided with a ladder, flambeaux, and other things to expedite our deſcent, our whole company, man by man, ventured into the ſame opening, and deſcending one after another, we at laſt ſaw ourſelves all together in the moſt magnificent part of the cavern.

"Our candles being now all lighted up, and the whole place completely illuminated, never could the eye be preſented with a more glittering, or a more magnificent ſcene. The roof all hung with ſolid iſicles, tranſparent as glaſs, yet ſolid as marble. The eye could ſcarce reach the lofty and noble cieling; the ſides were regularly formed with ſpars; and the whole preſented the idea of a magnificent theatre, illuminated with an immenſe profuſion of lights. The floor conſiſted of ſolid marble; and in ſeveral places magnificent columns, thrones, altars, and other objects appeared, as if nature had deſigned to mock the curioſities of art. Our voices, upon ſpeaking or ſinging, were redoubled to an aſtoniſhing loudneſs; and upon the firing of a gun, the noiſe and reverberations were almoſt deafening. In the midſt of this grand amphithreatre roſe a concretion of about fifteen feet high, that, in ſome meaſure, reſembled an altar; from which, taking the hint, we cauſed maſs to be celebrated there. The beautiful columns that ſhot up round the altar, appeared like candleſticks; and many other natural objects repreſented the cuſtomary ornaments of this ſacrament.

"Below even this ſpacious grotto, there ſeemed another cavern; down which I ventured with my former mariner, and deſcended about fifty paces by means of a rope. I at laſt arrived at a ſmall ſpot of level ground, where the bottom appeared different from that of the amphitheatre, being compoſed of ſoft clay, yielding to the preſſure, and in which I thruſt a ſtick to about ſix feet deep. In this, however, as above, numbers of the moſt beautiful chryſtals were formed; one of which, particularly, reſembled a table. Upon our egreſs from this amazing cavern, we perceived a Greek inſcription upon a rock at the mouth, but ſo obliterated by time, that we could not read it. It ſeemed to import that one Antipater, in the time of Alexander, had come thither; but whether he penetrated into the depths of the cavern, he does not think fit to inform us."

Such is the account of this beautiful ſcene, as communicated in a letter to Kircher. We have another, and a more copious deſcription of it by Tournefort, which is in every body's hands; but we have given the above, both becauſe it was communicated by the firſt diſcoverer, and becauſe it is a ſimple narrative of facts, without any reaſoning upon them. According to Tournefort's account, indeed, we might conclude, from the rapid growth of the ſpars in this grotto, that it muſt every year be

be growing narrower, and that it muſt, in time, be choaked up with them entirely; but no ſuch thing has happened hitherto, and the grotto at this day continues as ſpacious as we ever knew it.

This is not a place for an enquiry into the ſeeming vegetation of thoſe ſtony ſubſtances with which this and almoſt every cavern are incruſted. It is enough to obſerve, in general, that they are formed by an accumulation of that little gritty matter which is carried thither by the waters, and which in time acquires the hardneſs of marble. What in this place more imports us to know is, how theſe amazing hollows in the earth came to be formed. In the three inſtances above-mentioned, it is pretty evident, that their excavation has been owing to water. Theſe finding ſubterraneous paſſages under the earth, and by long degrees hollowing the beds in which they flowed, the ground above them has ſlipt down cloſer to their ſurface, leaving the upper layers of the earth or ſtone ſtill ſuſpended. The ground that ſinks upon the face of the waters forming the floor of the cavern; the ground, or rock that keeps ſuſpended, forming the roof: and, indeed, there are but few of theſe caverns found without water, either within them, or near enough to point out their formation.

CHAP. VIII.

Of MINES, DAMPS, and Mineral VAPOURS.

THE caverns, which we have been deſcribing, generally carry us but a very little way below the ſurface of the earth. Two hundred feet, at the utmoſt, is as much as the loweſt of them is found to ſink. The perpendicular fiſſures run much deeper; but few perſons have been bold enough to venture down to their deepeſt receſſes: and ſome few who have tried, have been able to bring back no tidings of the place, for unfortunately they left their lives below. The excavations of art have conducted us much farther into the bowels of the globe. Some mines in Hungary are known to be a thouſand yards perpendicular downwards; and we have been informed, by good authority, of a coal mine in the north of England, an hundred yards deeper ſtill.

It is beſide our preſent purpoſe to enquire into the peculiar conſtruction and contrivance of theſe, which more properly belongs to the hiſtory of foſſils. It will be ſufficient to obſerve in this place, that as we deſcend into the mines, the various layers of earth are ſeen, as we have already deſcribed them; and in ſome of theſe are always found the metals or minerals, for which the mine has been dug. Thus frequently gold is found diſperſed and mixed with clay and gravel; ſometimes it is mingled with other metallic bodies, ſtones, or bitumens; and ſometimes united with that moſt obſtinate of all ſubſtances, platina, from which ſcarce any art can ſeparate it. Silver is ſometimes found quite pure, ſometimes mixed with other ſubſtances and minerals. Copper is found in beds mixed with various ſubſtances, marbles, ſulphurs, and pyrites. Tin, the ore of which is heavier than that of any other metal, is generally found mixed with every kind of matter: lead is alſo equally common; and iron we well know can be extracted from all the ſubſtances upon earth.

The variety of ſubſtances which are thus found in the bowels of the earth, in their native ſtate, have a very different appearance from what they are afterwards taught to aſſume by human induſtry. The richeſt metals are very often leſs glittering and ſplendid than the moſt uſeleſs marcaſites, and the baſeſt ores are in general the moſt beautiful to the eye.

This variety of ſubſtances, which compoſe the internal parts of our globe, is productive of equal varieties both above and below its ſurface. The combination of the different minerals with each other, the heats which ariſe from their mixture, the vapours they diffuſe, the fires which they generate, or the colds which they ſometimes produce, are all either noxious or ſalutary to man; ſo that in this great elaboratory of nature, a thouſand benefits and calamities are forging, of which we are wholly unconſcious; and it is happy for us that we are ſo.

Upon our deſcent into mines of conſiderable depth, the cold ſeems to increaſe from the mouth as we deſcend; but after paſſing very low down, we begin, by degrees, to come into a warmer air, which ſenſibly grows hotter as we go deeper, till, at laſt, the labourers can ſcarce bear any covering as they continue working.

This difference in the air was ſuppoſed by Boyle to proceed from magazines of fire that lay nearer the centre, and that diffuſed their heat to the adjacent regions. But we now know that it may be aſcribed to more obvious cauſes. In ſome mines, the compoſition of the earth all around is of ſuch a nature, that upon the admiſſion of water or air, it frequently becomes hot, and often burſts out into eruptions. Beſides this, as the external air, cannot readily reach the bottom, or be renewed there, and obſervable heat is perceived below, without the neceſſity of recurring to the central heat for an explanation.

Hence, therefore, there are two principal cauſes of the warmth at the bottom of mines: the heat of the ſubſtances of which the ſides are compoſed; and the want of renovation in the air below. Any ſulphureous ſubſtance mixed with iron, produces a very great heat, by the admiſſion of water. If, for inſtance, a quantity of ſulphur be mixed with a proportionable ſhare of iron filings, and both kneaded together into a ſoft paſte, with water, they will ſoon grow hot, and at laſt produce a flame. This experiment, produced by art, is very commonly effected within the bowels of the earth by nature. Sulphurs and irons are intimately blended together, and want only the mixture of water or air to excite their heat; and this, when once raiſed, is communicated to all bodies that lie within the ſphere of their operation. Thoſe beautiful minerals called marcaſites and pyrites, are often of this compoſition; and wherever they are found, either by imbibing the moiſture of the air, or having been by any means combined with water, they render the mine conſiberably hot.

The want of freſh air, alſo, at theſe depths, is, as we have ſaid, another reaſon for their being found much hotter. Indeed, without the aſſiſtance of art, the bottom of moſt mines would, from this cauſe, be inſupportable. To remedy this inconvenience, the miners are often obliged to ſink, at ſome convenient diſtance from the mouth of the pit where they are at work, another pit, which joins the former below, and which, in Derbyſhire, is called an air-ſhaft. Through this the air circulates; and thus the workmen are enabled to breathe freely at the bottom of the place; which becomes, as Mr. Boyle affirms, very commodious for reſpiration; and alſo very temperate as to heat and cold. Mr. Locke, however, who has left us an account of the Mendip mines, ſeems to preſent a different picture. "The deſcent into theſe is exceeding difficult and dangerous; for they are not ſunk like wells, perpendicularly, but as the crannies of the rocks happen to run. The conſtant method is to ſwing down by a rope, placed under the arms, and clamber along, by applying both feet and hands to the ſides of the narrow paſſage. The air is coveyed into them through a little paſſage that runs along the ſides from the top, where they ſet up ſome turfs, on the lee-ſide of the hole, to catch and force it down. Theſe turfs being removed to the windy ſide, or laid over the

the mouth of the hole, the miners below preſently want breath, and faint; and if ſweet-ſmelling flowers chance to be placed there, they immediately loſe their fragrancy, and ſtink like carrion." An air ſo very putrifying can never be very commodious for reſpiration.

Indeed, if we examine the complexion of moſt miners, we ſhall be very well able to form a judgment of the unwholeſomeneſs of the place where they are confined. Their pale and ſallow looks ſhew how much the air is damaged by paſſing through thoſe deep and winding ways, that are rendered humid by damps, or warmed with noxious exhalations. But although every mine is unwholeſome, all are not equally ſo. Coal-mines are generally leſs noxious than thoſe of tin; tin than thoſe of copper; but none are ſo dreadfully deſtructive as thoſe of quickſilver. At the mines near the village of Idra, nothing can adequately deſcribe the deplorable infirmities of ſuch as fill the hoſpital there: emaciated and crippled, every limb contracted or convulſed, and ſome in a manner tranſpiring quickſilver at every pore. There was one man, ſays Dr. Pope, who was not in the mines above half a year, and yet whoſe body was ſo impregnated with this mineral, that putting a piece of braſs money in his mouth, or rubbing it between his fingers, it immediately became as white as if it had been waſhed over with quickſilver. In this manner all the workmen are killed ſooner or later; firſt becoming paralytic, and then dying conſumptive: and all this they ſuſtain for the trifling reward of ſeven-pence a day.

But theſe metallic mines are not ſo noxious from their own vapours, as from thoſe of the ſubſtances with which the ores are uſually united, ſuch as arſenic, cinnabar, bitumen, or vitriol. From the fumes of theſe, variouſly combined, and kept encloſed, are produced thoſe various damps that put on ſo many dreadful forms, and are uſually ſo fatal. Sometimes thoſe noxious vapours are perceived by the delightful fragrance of their ſmell, ſomewhat reſembling the pea-bloſſom in bloom, from whence one kind of damp has its name. The miners are not deceived, however, by its flattering appearances; but as they have thus timely notice of its coming, they avoid it while it continues, which is generally during the whole ſummer ſeaſon. Another ſhews its approach by the burning of the candles, which ſeem to collect their flame into a globe of light, and thus gradually leſſen, till they are quite extinguiſhed. From this alſo the miners frequently eſcape; however, ſuch as have the misfortune to be caught in it; either ſwoon away, and are ſuffocated, or ſlowly recover in exceſſive agonies. Here alſo is a third, called the fulminating damp, much more dangerous than either of the former, as it ſtrikes down all before it, like a flaſh of gunpowder, without giving any warning of its approach. But there is another, more dangerous than all the reſt, which is found in thoſe places where the vapour has been long confined, and has been, by ſome accident, ſet free. The air ruſhing out from thence, always goes upon deadly errands; and ſcarce any eſcape to deſcribe the ſymptoms of its operations.

Some colliers in Scotland, working near an old mine that had been long cloſed up, happened inadvertently to open an hole into it, from the pit where they were then employed; luckily they at that time perceived their error, and inſtantly fled for their lives. The next day, however, they were reſolved to renew their work in the ſame pit, and eight of them ventured down, without any great apprehenſions; but they had ſcarce got to the bottom of the ſtairs that led to the pit, but coming within the vapour, they all inſtantly dropped down dead, as if they had been ſhot. Amongſt theſe unfortunate poor men, there was one whoſe wife was informed that he was ſtifled in the mine; and as he happened to be next the entrance, ſhe ſo far ventured down as to ſee where he lay. As ſhe approached the place, the ſight of her huſband inſpired her with a deſire to reſcue him, if poſſible, from that dreadful ſituation; though a little reflection might have ſhewn her it was then too late. But nothing could deter her: ſhe ventured forward, and had ſcarce touched him with her hand, when the damp prevailed, and the miſguided, but faithful creature, fell dead by his ſide.

Thus, the vapours found beneath the ſurface of the earth, are very various in their effects upon the conſtitution: and their are not leſs in their appearances. There are many kinds that ſeemingly are no way prejudicial to health, but in which the workmen breathe freely; and yet in theſe, if a lighted candle be introduced, they immediately take fire, and the whole cavern at once becomes one furnace of flame. In mines, therefore, ſubject to damps of this kind, they are obliged to have recourſe to a very peculiar contrivance to ſupply ſufficient light for their operations. This is by a great wheel; the circumference of which is beſet with flints, which ſtriking againſt ſteels placed for that purpoſe at the extremity, a ſtream of fire is produced, which affords light enough; and yet which does not ſet fire to the mineral vapour.

Of this kind are the vapours of the mines about Briſtol: on the contrary, in other mines a ſingle ſpark ſtruck out from the colliſion of flint and ſteel, would ſet the whole ſhaft in a flame. In ſuch, therefore, every precaution is uſed to avoid a colliſion; the workmen making uſe only of wooden inſtruments in digging; and being cautious before they enter the mine, to take out even the nails from their ſhoes. Whence this ſtrange difference ſhould ariſe, that the vapours of ſome mines catch fire with a ſpark, and others only with a flame, is a queſtion that we muſt be content to leave in obſcurity, till we know more of the nature both of mineral vapour and of fire. This only we may obſerve, that gunpowder will readily fire with a ſpark, but not with the flame of a candle: on the other hand, ſpirits of wine will flame with a candle, but not with a ſpark; but even here the cauſe of this difference, as yet, remains a ſecret.

As from this account of mines, it appears that the internal parts of the globe are filled with vapours of various kinds, it is not ſurpriſing, that they ſhould at different times reach the ſurface, and there put on various appearances. In fact, much of the ſalubrity, and much of the unwholeſomeneſs of climates and ſoils, is to be aſcribed to theſe vapours, which make their way from the bowels of the earth upwards, and refreſh or taint the air with their exhalations. Salt mines being naturally cold, ſend forth a degree of coldneſs to the external air, to comfort and refreſh it: on the contrary, metallic mines are known, not only to warm it with their exhalations, but often to deſtroy all kinds of vegetation by their volatile corroſive fumes. In ſome mines denſe vapours are plainly perceived iſſuing from their mouths, and ſenſibly warm to the touch. In ſome places, neither ſnow nor ice will continue on the ground that covers a mine; and over others the fields are found deſtitute of verdure. The inhabitants, alſo, are rendered dreadfully ſenſible of theſe ſubterraneous exhalations, being affected with ſuch a variety of evils proceeding entirely from this cauſe, that books have been profeſſedly written upon this claſs of diſorders.

Nor are theſe vapours which thus eſcape to the ſurface of the earth, entirely unconfined; for they are frequently, in a manner circumſcribed to a ſpot: the grotto Del Cane, near Naples, is an inſtance of this;

this; the noxious effects of which have made that cavern ſo very famous. This grotto, which has ſo much employed the attention of travellers, lies within four miles of Naples, and is ſituated near a large lake of clear and wholeſome water. Nothing can exceed the beauty of the landſcape which this lake affords; being ſurrounded with hills covered with foreſts of the moſt beautiful verdure, and the whole bearing a kind of amphitheatrical appearance. However, this region, beautiful as it appears, is almoſt entirely uninhabited; the few peaſants that neceſſity compels to reſide there, looking quite conſumptive and ghaſtly, from the poiſonous exhalations that riſe from the earth. The famous grotto lies on the ſide of an hill, near which place a peaſant reſides, who keeps a number of dogs for the purpoſe of ſhewing the experiment to the curious. Theſe poor animals always ſeem perfectly ſenſible of the approach of a ſtranger, and endeavour to get out of the way. However, their attempts being perceived, they are taken and brought to the grotto; the noxious effects of which they have ſo frequently experienced. Upon entering this place, which is a little cave, or rather a hole dug into the hill, about eight feet high and twelve feet long, the obſerver can ſee no viſible marks of its peſtilential vapour; only to about a foot from the bottom, the wall ſeems to be tinged with a colour reſembling that which is given by ſtagnant waters. When the dog, this poor philoſophical martyr, as ſome have called him, is held above this mark, he does not ſeem to feel the ſmalleſt inconvenience; but when his head is thruſt down lower, he ſtruggles to get free for a little; but in the ſpace of four or five minutes he ſeems to loſe all ſenſation, and to be taken out without life. Being plunged in the neighbouring lake, he quickly recovers, and is permitted to run home ſeemingly without the ſmalleſt injury.

This vapour, which thus for a time ſuffocates, is of the humid kind, as it extinguiſhes a torch, and ſullies a looking-glaſs: but there are other vapours perfectly inflamable, and that only require the approach of a candle to ſet them blazing. Of this kind was the burning well at Broſely, which is now ſtopped up; the vapour of which, when a candle was brought within about a foot of the ſurface of the water, caught flame like ſpirits of wine, and continued blazing for ſeveral hours after. Of this kind, alſo, are the perpetual fires in the kingdom of Perſia. In that province, where the worſhippers of fire hold their chief myſteries, the whole ſurface of the earth, for ſome extent, ſeems impregnated with inflammable vapours. A reed ſtruck into the ground continues to burn like a flambeaux; an hole made beneath the ſurface of the earth, inſtantly becomes a furnace anſwering all the purpoſes of a culinary fire. There they make lime by merely burying the ſtones in the earth, and watch with veneration the appearances of a flame that has not been extinguiſhed for times immemorial. How different are men in various climates! This deluded people worſhip theſe vapours as a deity, which in other parts of the world are conſidered as one of the greateſt evils.

CHAP. IX.

Of VOLCANOES and EARTHQUAKES.

MINES and caverns, as we have ſaid, reach but a very little way under the ſurface of the earth, and we have hitherto had no opportunities of exploring further. Without all doubt the wonders that are ſtill unknown ſurpaſs thoſe that have been repreſented, as there are depths of thouſands of miles which are hidden from our enquiry. The only tidings we have from thoſe unfathomable regions are by means of volcanoes, thoſe burning mountains that ſeem to diſcharge their materials from the loweſt abyſſes of the earth. A volcano may be conſidered as a cannon of immenſe ſize, the mouth of which is often near two miles in circumference. From this dreadful aperture are diſcharged torrents of flame and ſulphur, and rivers of melted metal. Whole clouds of ſmoke and aſhes, with rocks of enormous ſize, are diſcharged to many miles diſtance; ſo that the force of the moſt powerful artillery is but as a breeze agitating a feather, in compariſon. In the deluge of fire and melted matter which runs down the ſides of the mountain, whole cities are ſometimes ſwallowed up and conſumed. Thoſe rivers of liquid fire are often two hundred feet deep; and, when they harden, frequently form conſiderable hills. Nor is the danger of theſe confined to the eruption only: but the force of the internal fire ſtruggling for vent, frequently produces earthquakes through the whole region where the volcano is ſituated. So dreadful have been theſe appearances, that men's terrors have added new horrors to the ſcene, and they have regarded as prodigies, what we know to be the reſult of natural cauſes. Some philoſophers have conſidered them as vents communicating with the fires of the centre, and the ignorant as the mouths of hell itſelf. Aſtoniſhment produces fear, and fear ſuperſtition: the inhabitants of Iceland believe the bellowings of Hecla are nothing elſe but the cries of the damned, and that its eruptions are contrived to encreaſe their tortures.

But if we regard this aſtoniſhing ſcene of terror with a more tranquil and inquiſitive eye, we ſhall find that theſe conflagrations are produced by very obvious and natural cauſes. We have already been apprized of the various mineral ſubſtances in the boſom of the earth, and their aptneſs to burſt out into flames. Marcaſites and pyrites, in particular, by being humified with water, or air, contract this heat, and often endeavour to expand with irreſiſtible exploſion. Theſe, therefore, being lodged in the depths of the earth, nor in the boſom of mountains, and being either waſhed by the accidental influx of waters below, or fanned by air, inſinuating itſelf through perpendicular fiſſures from above, take fire at firſt by only heaving in earthquakes, but at length by burſting through every obſtacle, and making their dreadful diſcharge in a volcano.

Theſe volcanoes are found in all parts of the earth: in Europe there are three that are very remarkable; Ætna in Sicily, Veſuvius in Italy, and Hecla in Iceland. Ætna has been a volcano for ages immemorial. Its eruption are very violent, and its diſcharge has been known to cover the earth ſixty-eight feet deep. In the year 1537, an eruption of this mountain produced an earthquake through the whole iſland, for twelve days, overturned many houſes, and at laſt formed a new aperture which overwhelmed all within five leagues round. The cinders thrown up were driven even into Italy, and its burning were ſeen at Malta, at the diſtance of ſixty leagues. There is nothing more awful, ſays Kircher, than the eruptions of this mountain, nor nothing more dangerous than attempting to examine its appearances, even long after the eruption has ceaſed. As we attempt to clamber up its ſteepy ſides, every ſtep we take upward, the feet ſink back half way. Upon arriving near the ſummit, aſhes and ſnow, with an ill aſſorted conjunction, preſent nothing but objects of deſolation. Nor is this the worſt, for, as all places are covered over, many caverns are intirely hidden from the ſight, into which, if the enquirer happens to fall, he ſinks to the bottom and meets inevitable deſtruction. Upon coming to the edge of the great crater, nothing can ſufficiently

ficiently repreſent the tremendous magnificence of the ſcene. A gulph two miles over, and ſo deep that no bottom can be ſeen; on the ſides pyramidical rocks ſtarting out between apertures that emit ſmoke and flame; all this accompanied with a ſound that never ceaſes, louder than thunder, ſtrikes the bold with horror, and the religious with veneration for him that has power to controul its burnings.

In the deſcriptions of Veſuvius, or Hecla, we ſhall find ſcarce any thing but a repetition of the ſame terrible objects, though rather leſſened, as theſe mountains are not ſo large as the former. The crater of Veſuvius is but a mile acroſs, according to the ſame author; whereas that of Ætna is two. On this particular, however, we muſt place no dependence, as theſe caverns every day alter; being leſſened by the mountains ſinking in at one eruption, and enlarged by the fury of another. It is not one of the leaſt remarkable particulars reſpecting Veſuvius, that Pliny the naturaliſt was ſuffocated in one of its eruptions; for his curioſity impelled him too near, he found himſelf involved in ſmoke and cinders when it was too late to retire; and his companions hardly eſcaped to give an account of the misfortune. It was in that dreadful eruption that the city of Herculaneum was overwhelmed; the ruins of which have been lately diſcovered at ſixty feet diſtance below the ſurface, and what is ſtill more remarkable, forty feet below the bed of the ſea. One of the moſt remarkable eruptions of this mountain was in the year 1707, which is finely deſcribed by Valetta, a part of whoſe deſcription we beg leave to tranſlate.

"Towards the latter end of ſummer, in the year 1707, the mount Veſuvius, that had for a long time been ſilent, now began to give ſome ſigns of commotion. Little more than internal murmurs at firſt were heard, that ſeemed to contend within the loweſt depths of the mountain; no flame, nor even any ſmoak, was as yet ſeen. Soon after ſome ſmoak appeared by day, and a flame by night, which ſeemed to brighten all the Campania. At intervals alſo it ſhot off ſubſtances with a ſound very like that of artillery, but which, even at ſo great a diſtance as we were at, infinitely exceeded them in greatneſs. Soon after it began to throw up aſhes, which becoming the ſport of the winds, fell at great diſtances, and ſome many miles. To this ſucceeded ſhowers of ſtones, which killed many of the inhabitants of the valley, but made a dreadful ravage among the cattle. Soon after a torrent of burning matter began to roll down the ſides of the mountain, at firſt with a ſlow and gentle motion, but ſoon with increaſed celerity. The matter thus poured out, when cool, ſeemed, upon inſpection, to be of a vitrified earth, the whole united into a maſs of more than ſtony hardneſs. But what was particularly obſervable was, that upon the whole ſurface of theſe melted materials, a light ſpongy ſtone ſeemed to float, while the lower body was of the hardeſt ſubſtance, of which our roads are uſually made. Hitherto there were no appearances but what had been often remarked before; but on the third or fourth day, ſeeming flaſhes of lightning were ſhot forth from the mouth of the mountain, with a noiſe far exceeding the loudeſt thunder. Theſe flaſhes, in colour and brightneſs, reſembled what we uſually ſee in tempeſts, but they aſſumed a more twiſted and ſerpentine form. After this followed ſuch clouds of ſmoak and aſhes, that the whole city of Naples, in the midſt of the day, was involved in nocturnal darkneſs, and the neareſt friends were unable to diſtinguiſh each other in this frightful gloom. If any perſon attempted to ſtir out without torch-light, he was obliged to return, and every part of the city was filled with ſupplications and terror; at length after a continuance of ſome hours, about one o'clock at midnight, the wind blowing from the north, the ſtars began to be ſeen; the heavens, though it was night, began to grow brighter; and the eruptions, after a continuance of fifteen days, to leſſen. The torrent of melted matter was ſeen to extend from the mountain down to the ſhore; the people began to return to their former dwellings, and the whole face of nature to reſume its former appearance."

Biſhop Berkley gives an account of one of theſe eruptions in a manner ſomething different from the former. "In the year 1717, and the middle of April, with much difficulty I reached the top of mount Veſuvius, in which I ſaw a vaſt aperture full of ſmoak, which hindered me from ſeeing its depth and figure. I heard within that horrid gulph certain extraordinary ſounds, which ſeemed to proceed from the bowels of the mountain, a ſort of murmuring, ſighing, daſhing ſound, and between whiles a noiſe like that of thunder or cannon, with a clattering like that of tiles falling from the tops of houſes into the ſtreets. Sometimes, as the wind changed, the ſmoak grew thinner, diſcovering a very ruddy flame, and the circumference of the crater ſtreaked with red and ſeveral ſhades of yellow. After an hour's ſtay, the ſmoak being moved by the wind, gave us ſhort and partial proſpects of the great hollow; in the flat bottom of which I could diſcern two furnaces almoſt contiguous; that on the left ſeeming about three yards over, glowing with ruddy flame, and throwing up red hot ſtones, with an hideous noiſe, which, as they fell back, cauſed the clattering already taken notice of. May 8, in the morning, I aſcended the top of Veſuvius a ſecond time, and found a different face of things. The ſmoak aſcending upright, gave a full proſpect of the crater, which, as I could judge, was about a mile in circumference, and an hundred yards deep. A conical mount had been formed ſince my laſt viſit in the middle of the bottom, which I could ſee was made by the ſtones, thrown up and fallen back again into the crater. In this new hill remained the two furnaces already mentioned. The one was ſeen to throw up every three or four minutes, with a dreadful ſound, a vaſt number of red hot ſtones, at leaſt three hundred feet higher than my head, as I ſtood upon the brink; but as there was no wind, they fell perpendicularly back from whence they had been diſcharged. The other was filled with red hot liquid matter, like that in the furnace of a glaſs-houſe; raging and working like the waves of the ſea, with a ſhort abrupt noiſe. This matter would ſometimes boil over, and run down the ſide of the conical hill, appearing at firſt red hot, but changing colour as it hardened and cooled. Had the wind driven in our faces, we had been in no ſmall danger of ſtifling by the ſulphureous ſmoak, or being killed by the maſſes of melted minerals, that were ſhot from the bottom. But as the wind was favourable, I had an opportunity of ſurveying this amazing ſcene for above an hour and an half together. On the fifth of June, after an horrid noiſe, the mountain was ſeen at Naples to work over; and about three days after, its thunders were renewed ſo, that not only the windows in the city, but all the houſes ſhook. From that time it continued to overflow, and ſometimes at night were ſeen columns of fire ſhooting upward from its ſummit. On the tenth, when all was thought to be over, the mountain again renewed its terrors, roaring and raging moſt violently. One cannot form a juſter idea of the noiſe, in the moſt violent fits of it, than by imagining a mixed ſound, made up of the raging of a tempeſt, the murmur of a troubled ſea, and the roaring of thunder and artillery, confuſed all together. Though we heard this at the diſtance of twelve

twelve miles, yet it was very terrible. I therefore reſolved to approach nearer to the mountain; and, accordingly, three or four of us got into a boat, and were ſet aſhore at a little town, ſituated at the foot of the mountain. From thence we rode about four or five miles, before we came to the torrent of fire that was deſcending from the ſide of the volcano; and here the roaring grew exceeding loud and terrible as we approached. I obſerved a mixture of colours in the cloud, above the crater, green, yellow, red, blue. There was likewiſe a ruddy diſmal light in the air, over that tract where the burning river flowed. Theſe circumſtances, ſet off and augmented by the horror of the night, made a ſcene the moſt uncommon and aſtoniſhing I ever ſaw; which ſtill increaſed as we approached the burning river. Imagine a vaſt torrent of liquid fire, rolling from the top, down the ſide of the mountain, and with irreſiſtible fury bearing down and conſuming vines, olives, and houſes; and divided into different channels, according to the inequalities of the mountain. The largeſt ſtream ſeemed half a mile broad at leaſt, and five miles long. I walked ſo far before my companions up the mountain, along the ſide of the river of fire, that I was obliged to retire in great haſte, the ſulphurcous ſteam having ſurpriſed me, and almoſt taken away by breath. During our return, which was about three o'clock in the morning, the roaring of the mountain was heard all the way, while we obſerved it throwing up huge ſpouts of fire and burning ſtones, which falling, reſembled the ſtars in a rocket. Sometimes I obſerved two or three diſtinct columns of flame, and ſometimes one only that was large enough to fill the whole crater. Theſe burning columns, and fiery ſtones, ſeemed to be ſhot a thouſand feet perpendicular above the ſummit of the volcano: and in this manner the mountain continued raging for ſix or eight days after. On the eighteenth of the ſame month the whole appearance ended, and the mountain remained perfectly quiet, without any viſible ſmoke or flame."

The matter which is found to roll down from the mouth of all volcanoes in general, reſembles the droſs that is thrown from a ſmith's forge. But it is different, perhaps, in various parts of the globe; for, as we have already ſaid, there is not a quarter of the world that has not its volcanoes. In Aſia, particularly in the iſlands of the Indian ocean, there are many. One of the moſt famous is that of Albouras, near Mount Taurus, the ſummit of which is continually on fire, and covers the whole adjacent country with aſhes. In the iſland of Ternate there is a volcano, which ſome travellers aſſert, burns moſt furiouſly in the times of the equinoxes, becauſe of the winds which then contribute to increaſe the flames. In the Molucca iſlands there are many burning mountains; they are alſo ſeen in Japan, and the iſlands adjacent; and in Java and Sumatra, as well as in other of the Philipine iſlands. In Africa there is a cavern, near Fez, which continually ſends forth either ſmoke or flames. In the Cape de Verde iſlands, one of them, called the Iſland del Fuego, continually burns; and the Portugueſe, who frequently attempted a ſettlement there, have as often been obliged to deſiſt. The Peak of Teneriffe is, as every body knows, a volcano that ſeldom deſiſts from eruptions. But of all parts of the earth, America is the place where thoſe dreadful irregularities of nature are the moſt conſpicuous. Veſuvius, and Ætna itſelf, are but mere fire-works, in compariſon to the burning mountains of the Andes; which as they are the higheſt mountains of the world, ſo alſo are they the moſt formidable for their eruptions. The mountain of Arequipa in Peru, is one of the moſt celebrated; Caxamalca, and Malahallo, are very conſiderable; but that of Cotopaxi, in the province of Quito, exceeds any thing we have hitherto read or heard of. The mountain of Cotopaxi, as deſcribed by Ulloa, is more than three miles perpendicular from the ſea; and it became a volcano at the time of the Spaniards firſt arrival in that country. A new eruption of it happened in the year 1743, having been ſome days preceded by a continual roaring in its bowels. The ſound of one of theſe mountains is not like that of the volcanoes in Europe, confined to a province, but is heard at an hundred and fifty miles diſtance. An aperture was made in the ſummit of this immenſe mountain; and three more about equal heights, near the middle of its declivity, which was at that time buried under prodigious maſſes of ſnow. The ignited ſubſtances ejected on that occaſion, mixed with a prodigious quantity of ice and ſnow, melting amidſt the flames, were carried down with ſuch aſtoniſhing rapidity, that in an inſtant the valley from Callo to Latacunga was overflowed; and beſides its ravages in bearing down the houſes of the Indians, and other poor inhabitants, great numbers of people loſt their lives. The river of Latacunga was the channel of this terrible flood; till being too ſmall for receiving ſuch a prodigious current, it overflowed the adjacent country, like a vaſt lake, near the town, and carried away all the buildings within its reach. The inhabitants retired into a ſpot of higher ground behind the town, of which thoſe parts which ſtood within the limits of the current were totally deſtroyed. The dread of ſtill greater devaſtations did not ſubſide for three days; during which, the volcano ejected cinders, while torrents of melted ice and ſnow poured down its ſides. The eruption laſted ſeveral days, and was accompanied with terrible roarings of the wind, ruſhing through the volcano ſtill louder than the former rumblings in its bowels. At laſt all was quiet, neither fire nor ſmoke to be ſeen, nor noiſe to be heard; till, in the enſuing year, the flames again appeared with recruited violence, forcing their paſſage through ſeveral other parts of the mountain, ſo that in clear nights the flames being reflected by the tranſparent ice, formed an awfully magnificent illumination.

Such is the appearance and the effect of thoſe fires which proceed from the more inward receſſes of the earth; for that they generally come from deeper regions than man has hitherto explored, we cannot avoid thinking, contrary to the opinion of Mr. Buffon, who ſuppoſes them rooted but a very little way below the bed of the mountain. We can never ſuppoſe, ſays this great naturaliſt, that theſe ſubſtances are ejected from any great diſtance, below, if we only conſider the great force already required to fling them up to ſuch vaſt heights above the mouth of the mountain; if we conſider the ſubſtances thrown up, which we ſhall find upon inſpection to be the ſame with thoſe of the mountain below; if we take into our conſideration, that air is always neceſſary to keep up the flame; but, moſt of all, if we attend to one circumſtance, which is, that if theſe ſubſtances were exploded from a vaſt depth below, the ſame force required to ſhoot them up ſo high, would act againſt the ſides of the volcano, and tear the whole mountain in pieces. To all this ſpecious reaſoning, particular anſwers might eaſily be given; as that the length of the funnel increaſes the force of the exploſion; that the ſides of the funnel are actually often burſt with the great violence of the flame; that air may be ſuppoſed at depths at leaſt as far as the perpendicular fiſſures deſcend. But the beſt anſwer is a well-known fact; namely, that the quantity of matter diſcharged from Ætna alone, is ſuppoſed, upon a moderate computation, to exceed twenty times the original bulk of the mountain. The greateſt part of Sicily ſeems

covered

covered with its eruptions. The inhabitants of Catanea have found, at the diſtance of ſeveral miles, ſtreets and houſes, ſixty feet deep, overwhelmed by the lava or matter it has diſcharged. But what is ſtill more remarkable, the walls of theſe very houſes have been built of materials evidently thrown up by the mountain. The inference from all this is very obvious; that the matter thus exploded cannot belong to the mountain itſelf, otherwiſe, it would have been quickly conſumed; it cannot be derived from moderate depths, ſince its amazing quantity evinces, that all the places near the bottom muſt have long ſince been exhauſted; nor can it have any extenſive, and, if we may ſo call it, a ſuperficial ſpread, for then the country round would be quickly undermined; it muſt, therefore, be ſupplied from the deeper regions of the earth; thoſe undiſcovered tracts where the Deity performs his wonders in ſolitude, ſatisfied with ſelf-approbation!

CHAP. X.

Of EARTHQUAKES.

HAVING given the theory of volcanoes, we have in ſome meaſure given alſo that of earthquakes. They both ſeem to proceed from the ſame cauſe, only with this difference, that the fury of the volcano is ſpent in the eruption, that of an earthquake ſpreads wider and acts more fatally by being confined. The volcano only affrights a province, earthquakes have laid whole kingdoms in ruin.

Philoſophers have taken ſome pains to diſtinguiſh between the various kinds of earthquakes, ſuch as the tremulous, the pulſative, the perpendicular, and the inclined; but theſe are rather the diſtinctions of art than of nature, mere accidental differences ariſing from the ſituation of the country or of the cauſe. If, for inſtance, the confined fire acts directly under a province or a town, it will heave the earth perpendicularly upward, and produce a perpendicular earthquake. If it acts at a diſtance, it will raiſe that tract obliquely, and thus the inhabitants will perceive an inclined one.

Nor does it ſeem that there is much greater reaſon for Mr. Buffon's diſtinction of earthquakes. One kind of which he ſuppoſes to be produced by fire in the manner of volcanoes, and confined but to a very narrow circumference. The other kind he aſcribes to the ſtruggles of confined air, expanded by heat in the bowels of the earth, and endeavouring to get free. For how do theſe two cauſes differ? Fire is an agent of no power whatſoever without air. It is the air, which being at firſt compreſſed, and then dilated in a cannon, that drives the ball with ſuch force. It is the air ſtruggling for vent in a volcano, that throws up its contents to ſuch vaſt heights. In ſhort, it is the air confined in the bowels of the earth, and acquiring elaſticity by heat, that produces all thoſe appearances generally aſcribed to the operation of fire. When, therefore, we are told that there are two cauſes of earthquakes, we only learn, that a greater or ſmaller quantity of heat produces thoſe terrible effects; for air is the only active operator in either.

Some philoſophers, however, have been willing to give the air as great a ſhare in producing theſe terrible efforts as they could; and, magnifying its powers, have called in but a very moderate degree of heat to put it in action. Although experience tells that the earth is full of inflammable materials, and that fires are produced wherever we deſcend; although it tells us that thoſe countries, where there are volcanoes, are moſt ſubject to earthquakes, yet they ſtep out of the way, and ſo find a new ſolution. These only allow but juſt heat enough to produce the moſt dreadful phœnomena, and backing their aſſertions with long calculations, give theory an air of demonſtration. Mr. Amontons has been particularly ſparing of the internal heat in this reſpect; and has ſhewn perhaps accurately enough, that a very moderate degree of heat may ſuffice to give the air amazing powers of expanſion.

It is aſtoniſhing, however, to trace the progreſs of a philoſophical fancy let looſe in imaginary ſpeculations. They run thus: "A very moderate degree of heat may bring the air into a condition capable of producing earthquakes; for the air at the depth of forty-three thouſand five hundred and twenty-eight fathom below the ſurface of the earth, becomes almoſt as heavy as quickſilver. This, however, is but a very ſlight depth in compariſion of the diſtance to the centre, and is ſcarce a ſeventieth part of the way. The air, therefore, at the centre muſt be infinitely heavier than mercury, or any body that we know of. This granted, we ſhall take ſomething more, and ſay, that it is very probable there is nothing but air at the centre. Now let us ſuppoſe this air heated, by ſome means, even to the degree of boiling water, as we have proved that the denſity of the air is here very great, its elaſticity muſt be in proportion: an heat, therefore, which at the ſurface of the earth would have produced but a ſlight expanſive force, muſt at the centre produce one very extraordinary, and, in ſhort, be perfectly irreſiſtible. Hence this force may with great eaſe produce earthquakes; and if increaſed it may convulſe the globe; it may (by only adding figures enough to the calculation) deſtroy the ſolar ſyſtem, and even the fixed ſtars themſelves." Theſe reveries generally produce nothing; for as we have often obſerved, increaſed calculations, while they ſeem to tire the memory, give the reaſoning faculty perfect repoſe.

However, as earthquakes are the moſt formidable miniſters of nature, it is not to be wondered that a multitude of writers have been curiouſly employed in their conſideration. Woodward has aſcribed the cauſe to a ſtoppage of the waters below the earth's ſurface, by ſome accident. Theſe being thus accumulated, and yet acted upon by fires, which he ſuppoſes ſtill deeper, both contribute to heave up the earth upon their boſom. This he thinks accounts for the lakes of water produced in an earthquake, as well as for the fires that ſometimes burſt from the earth's ſurface upon thoſe dreadful occaſions. There are others who have ſuppoſed that the earth may be itſelf the cauſe of its own convulſions. When, ſay they, the roots or baſis of ſome large tract is worn away by a fluid underneath, the earth ſinking therein, its weight occaſions a tremour of the adjacent parts, ſometimes producing a noiſe, and ſometimes an inundation of water. Not to tire the reader with an hiſtory of opinions inſtead of facts, ſome have aſcribed them to electricity, and ſome to the ſame cauſes that produce thunder.

It would be tedious, therefore, to give all the various opinions that have employed the ſpeculative upon this ſubject. The activity of the internal heat ſeems alone ſufficient to account for every appearance that attends theſe tremendous irregularities of nature. To conceive this diſtinctly, let us ſuppoſe at ſome vaſt diſtance under the earth, large quantities of inflammable matter, pyrites, bitumens, and marcaſites diſpoſed, and only waiting for the aſperſion of water, or the humidity of the air, to put their fires in motion; at laſt, this dreadful mixture arrives; waters find their way into thoſe depths, through the perpendicular fiſſures; or air inſinuates itſelf through the ſame minute apertures; immediately new appearances enſue: thoſe ſubſtances, which for ages before lay dormant, now conceive

new apparent qualities; they grow hot, produce new air and only want room for expanſion. However, the narrow apertures by which the air or water had at firſt admiſſion, are now cloſed up; yet as new air is continually generated, and as the heat every moment gives this air new elaſticity, it at length burſts, and dilates all round; and, in its ſtruggles to get free, throws all above it into ſimilar convulſions. Thus an earthquake is produced, more or leſs extenſive, according to the depth or the greatneſs of the cauſe.

But before we proceed with the cauſes, let us take a ſhort view of the appearances which have attended the moſt remarkable earthquakes. By theſe we ſhall ſee how far the theoriſt correſponds with the hiſtorian. The greateſt we find in antiquity, is that mentioned by Pliny, in which twelve cities in Aſia Minor were ſwallowed up in one night: he tells us alſo of another, near the lake Thraſymene, which was not perceived by the armies of the Carthaginians and Romans, that were then engaged near that lake, although it ſhook the greateſt part of Italy. In another place he gives the following account of an earthquake of an extraordinary kind. "When Lucius Marcus, and Sextus Julius, were conſuls, there appeared a very ſtrange prodigy of the earth, (as I have read in the books of Ætruſcan diſcipline) which happened in the province of Mutina. Two mountains ſhocked againſt each other, approaching and retiring with the moſt dreadful noiſe. They, at the ſame time, and in the midſt of the day, appeared to caſt forth fire and ſmoke, while a vaſt number of Roman knights and travellers from the Æmilian way, ſtood and continued amazed ſpectators. Several towns were deſtroyed by this ſhock; and all the animals that were near them were killed." In the times of Trajan, the city of Antioch, and a great part of the adjacent country, was buried by an earthquake. About three hundred years after, in the times of Juſtinian, it was once more deſtroyed, together with forty thouſand inhabitants: and, after an interval of ſixty years, the ſame ill-fated city was a third time overturned, with the loſs of not leſs than ſixty thouſand ſouls. In the year 1182, moſt of the cities of Syria, and the kingdom of Jeruſalem, were deſtroyed by the ſame accident. In the year 1594, the Italian hiſtorians deſcribe an earthquake at Puteoli, which cauſed the ſea to retire two hundred yards from its former bed.

But one of thoſe moſt particularly deſcribed in hiſtory, is that of the year 1693; the damages of which were chiefly felt in Sicily, but its motion perceived in Germany, France, and England. It extended to a circumference of two thouſand ſix hundred leagues; chiefly affecting the ſea-coaſts, and great rivers; more perceivable alſo upon the mountains than in the vallies. Its motions were ſo rapid, that thoſe who lay at their length, were toſſed from ſide to ſide, as upon a rolling billow. The walls were daſhed from their foundations; and no leſs than fifty-four cities, with an incredible number of villages, were either deſtroyed or greatly damaged. The city of Catanea, in particular, was utterly overthrown. A traveller, who was on his way thither, at the diſtance of ſome miles, perceived a black cloud, like night, hanging over the place. The ſea, all of a ſudden, began to roar; Mount Ætna to ſend forth great ſpires of flame; and ſoon after a ſhock enſued, with a noiſe as if all the artillery in the world had been at once diſcharged. Our traveller, being obliged to alight inſtantly, felt himſelf raiſed a foot from the ground; and turning his eyes to the city, he with amazement ſaw nothing but a thick cloud of duſt in the air. The birds flew about aſtoniſhed; the ſun was darkened; the beaſts ran howling from the hills; and, although the ſhock did not continue above three minutes, yet near nineteen thouſand of the inhabitants of Sicily periſhed in the ruins. Catanea, to which city the deſcriber was travelling, ſeemed the principal ſcene of ruin; its place only was to be found; and not a footſtep of its former magnificence was to be ſeen remaining.

The earthquake which happened in Jamaica, in 1692, was very terrible, and its deſcription ſufficiently minute. "In two minutes time it deſtroyed the town of Port-Royal, and ſunk the houſes in a gulph forty fathoms deep. It was attended with an hollow rumbling noiſe, like that of thunder; and, in leſs than a minute, three parts of the houſes, and their inhabitants, were all ſunk quite under water. While they were thus ſwallowed up on one ſide of the ſtreet or the other, the houſes were thrown into heaps; the ſand of the ſtreet riſing like the waves of the ſea, liſting up thoſe that ſtood upon it, and immediately overwhelming them in pits. All the wells diſcharged their waters with the moſt vehement agitation. The ſea felt an equal ſhare of turbulence, and, burſting over its mounds, deluged all that came in its way. The fiſſures of the earth were, in ſome places, ſo great, that one of the ſtreets appeared twice as broad as formerly. In many places, however, it opened and cloſed again, and continued this agitation for ſome time. Of theſe openings, two or three hundred might be ſeen at a time; in ſome whereof the people were ſwallowed up: in others, the earth cloſing, caught them by the middle, and thus cruſhed them inſtantly to death. Other openings, ſtill more dreadful than the reſt, ſwallowed up whole ſtreets; and others, more formidable, ſpouted up whole cataracts of water, drowning ſuch as the earthquake had ſpared. The whole was attended with the moſt noiſome ſtench; while the thundering of the diſtant falling mountains, the whole ſky overcaſt with a duſky gloom, and the craſh of falling habitations, gave unſpeakable horror to the ſcene. After this dreadful calamity was over, the whole iſland ſeemed converted into a ſcene of deſolation; ſcarce a planter's houſe was left ſtanding; almoſt all were ſwallowed up; houſes, people, trees, ſhared one univerſal ruin; and, in their places appeared great pools of water, which, when dried up by the ſun, left only a plain of barren ſand, without any veſtige of former inhabitants. Moſt of the rivers, during the earthquake, were ſtopt up by the falling in of the mountains; and it was not till after ſome time that they made themſelves new channels. The mountains ſeemed particularly attacked by the force of the ſhock; and it was ſuppoſed that the principal ſeat of the concuſſion was among them. Thoſe who were ſaved, got on board ſhips in the harbour; where many remained above two months, the ſhocks continuing during that interval with more or leſs violence every day."

As this deſcription ſeems to exhibit all the appearances that uſually make up the catalogue of terrors belonging to an earthquake, we will ſuppreſs the detail of that which happened at Liſbon, in our own times, and which is too recent to require a deſcription. In fact, there are few particulars in the accounts of thoſe who were preſent at that ſcene of deſolation, that we have not more minutely and accurately tranſmitted to us by former writers, whoſe narratives we have for that reaſon preferred. We will, therefore, cloſe this deſcription of human calamities, with the account of the dreadful earthquake at Calabria, in 1638. It is related by the celebrated Father Kircher, as it happened while he was on his journey to viſit Mount Ætna, and the reſt of the wonders that lie towards the ſouth of Italy. The reader, need ſcarce be informed, that Kircher is conſidered, by ſcholars, as one of the greateſt prodigies of learning.

"Having

"Having hired a boat, in company with four more, two friars of the order of St. Francis, and two seculars, we launched, on the twenty-four of March, from the harbour of Messina, in Sicily, and arrived, the same day, at the promontory of Pelorus. Our destination was for the city of Euphæmia, in Calabria, where we had some business to transact, and where we designed to tarry for some time. However, Providence seemed willing to cross our design; for we were obliged to continue for three days at Pelorus, upon account of the weather; and though we often put out to sea, yet we were as often driven back. At length, however, wearied with the delay, we resolved to prosecute our voyage; and, although the sea seemed more than usually agitated, yet we ventured forward. The gulph of Charybdis, which we approached, seemed whirled round in such a manner, as to form a vast hollow verging to a point in the centre. Proceeding onward, and turning my eyes to Ætna, I saw it cast forth large volumes of smoke, of mountainous sizes, which entirely covered the whole island, and blotted out the very shores from my view. This, together with the dreadful noise, and the sulphureous stench, which was strongly perceived, filled me with apprehensions that some more dreadful calamity was impending. The sea itself seemed to wear a very unusual appearance; those who have seen a lake in a violent shower of rain covered all over with bubbles, will conceive some idea of its agitations. My surprize was still encreased by the calmness and serenity of the weather; not a breeze, not a cloud which might be supposed to put all Nature thus into motion. I therefore warned my companions that an earthquake was approaching; and, after some time, making for the shore with all possible diligence, we landed at Tropæa, happy and thankful for having escaped the threatening dangers of the sea.

"But our triumphs at land were of short duration; for we had scarce arrived at the Jesuits College in that city, when our ears were stunned with an horrid sound, resembling that of an infinite number of chariots driven fiercely forward, the wheels rattling, and the thongs cracking. Soon after this, a most dreadful earthquake ensued; so that the whole tract upon which we stood seemed to vibrate, as if we were in the scale of a balance that continued wavering. This motion, however, soon grew more violent; and being no longer able to keep my legs, I was thrown prostrate upon the ground. In the mean time, the universal ruin round me redoubled my amazement. The crash of falling houses; the tottering of towers, and the groans of the dying, all contributed to raise my terror and despair. On every side of me I saw nothing but a scene of ruin; and danger threatening wherever I should fly. I commended myself to God as my last great refuge. At that hour, O how vain was every subluminary happiness! wealth, honour, empire, wisdom, all mere useless sounds, and as empty as the bubbles in the deep. Just standing on the threshold of eternity, nothing but God was my pleasure; and the nearer I approached, I only loved him the more. After some time, however, finding that I remained unhurt, amidst the general concussion, I resolved to venture for safety, and running as fast as I could, reached the shore, but almost terrified out of my reason. I did not search long here till I found the boat in which I had landed, and my companions also, whose terrors were even greater than mine. Our meeting was not of that kind where every one is desirous of telling his own happy escape; it was all silence, and a gloomy dread of impending terrors.

"Leaving this seat of desolation, we prosecuted our voyage along the coast; and the next day came to Rochetta, where we landed, although the earth still continued in violent agitations. But we were scarce arrived at our inn, when we were once more obliged to return to the boat; and, in about half an hour, we saw the greatest part of the town, and the inn at which we had set up, dashed to the ground, and burying all its inhabitants beneath its ruins.

"In this manner, proceeding onward in our little vessel, finding no safety at land, and yet, from the smallness of our boat, having but a very dangerous continuance at sea, we at length landed at Lopizium, a castle midway between Tropæa and Euphæmia, the city to which, as I said before, we were bound. Here, wherever I turned my eyes, nothing but scenes of ruin and horror appeared; towns and castles levelled to the ground; Strombalo, though at sixty miles distance, belching forth flames in an unusual manner, and with a noise which I could distinctly hear. But my attention was quickly turned from more remote to contiguous danger. The rumbling sound of an approaching earthquake, which we by this time were grown acquainted with, alarmed us for the consequences; it every moment seemed to grow louder, and to approach more near. The place on which we stood now began to shake most dreadfully; so that being unable to stand, my companions and I caught hold of whatever shrub grew next us, and supported ourselves in that manner.

"After some time, this violent paroxysm ceasing, we again stood up, in order to prosecute our voyage to Euphæmia, that lay within sight. In the mean time, while we were preparing for this purpose, I turned my eyes towards the city, but could see only a frightful dark cloud, that seemed to rest upon the place. This the more surprised us, as the weather was so very serene. We waited, therefore, till the cloud was past away: then turning to look for the city, it was totally sunk. Wonderful to tell! nothing but a dismal and putrid lake was seen where it stood. We looked about to find some one that could tell us of its sad catastrophe, but could see none. All was become a melancholy solitude; a scene of hideous desolation. Thus proceeding pensively along, in quest of some human being that could give us some little information, we at length saw a boy sitting by the shore, and appearing stupified with terror. Of him, therefore, we enquired concerning the fate of the city; but he could not be prevailed on to give us an answer. We entreated him with every expression of tenderness and pity to tell us; but his senses were quite wrapt up in the contemplation of the danger he had escaped. We offered him some victuals, but he seemed to loath the sight. We still persisted in our offices of kindness; but he only pointed to the place of the city, like one out of his senses; and then running up into the woods, was never heard of after. Such was the fate of the city of Euphæmia: and as we continued our melancholy course along the shore, the whole coast, for the space of two hundred miles, presented nothing but the remains of cities, and men scattered, without an habitation, over the fields. Proceeding thus along, we at length ended our distressful voyage by arriving at Naples, after having escaped a thousand dangers both at sea and land."

We hope the reader will excuse this long translation from a favourite writer, and that the sooner, as it contains some particulars relative to earthquakes not to be found elsewhere. From the whole of these accounts we may gather, than the most concomitant circumstances are these:

A rumbling sound before the earthquake. This proceeds from the air, or fire, or both, forcing their way through the chasms of the earth, and endeavouring

deavouring to get free, which is alſo heard in volcanoes.

A violent agitation, or heaving of the ſea, ſometimes before and ſometimes after that at land. This agitation is only a ſimilar effect produced on the waters with that at land, and may be called, for the ſake of perſpicuity, a ſea-quake; and this alſo is produced by volcanoes.

A ſpouting up of waters to great heights. It is not eaſy to deſcribe the manner in which this is performed; but volcanoes alſo perform the ſame, Veſuvius being known frequently to eject a vaſt body of water.

A rocking of the earth to and fro, and ſometimes a perpendicular bouncing, if it may be ſo called, of the ſame. This difference chiefly ariſes from the ſituation of the place with reſpect to the ſubterranean fire. Directly under it lifts; at a farther diſtance, it rocks.

Some earthquakes ſeem to travel onward, and are felt in different countries at different hours the ſame day. This ariſes from the great ſhock being given to the earth at one place, and that being communicated onward by an undulatory motion, ſucceſſively affects different regions in its progreſs; as the blow given by a ſtone falling in a lake is not perceived at the ſhores till ſome time after the firſt concuſſion.

The ſhock is ſometimes inſtantaneous, like the exploſion of gunpowder; and ſometimes tremulous, and continuing for ſeveral minutes. The nearer the place where the ſhock is firſt given, the more inſtantaneous and ſimple it appears. At a greater diſtance the earth redoubles the firſt blow, with a ſort of vibratory continuation.

As waters have generally ſo great a ſhare in producing earthquakes, it is not to be wondered that they ſhould generally follow thoſe breaches made by the force of fire, and appear in the great chaſms which the earthquake has opened.

Theſe are ſome of the moſt remarkable phœnomena of earthquakes, preſenting a frightful aſſemblage of the moſt terrible effects of air, earth, fire, and water.

The valley of Solfatara, near Naples, ſeems to exhibit, in a minuter degree, whatever is ſeen of this horrible kind on the great theatre of Nature. This plain, which is about twelve hundred feet long, and a thouſand broad, is emboſomed in mountains, and has in the middle of it a lake of noiſome blackiſh water, covered with a bitumen, that floats upon its ſurface. In every part of this plain, caverns appear ſmoking with ſulphur, and often emitting flames. The earth, wherever we walk over it, trembles beneath the feet. Noiſes of flames, and the hiſſing of waters, are heard at the bottom. The water ſometimes ſpouts up eight or ten feet high. The moſt noiſome fumes, fœtid water, and ſulphureous vapours, offend the ſmell. A ſtone thrown into any of the caverns, is ejected again with conſiderable violence. Theſe appearances generally prevail when the ſea is any way diſturbed; and the whole ſeems to exhibit the appearance of an earthquake in miniature. However, in this ſmaller ſcene of wonders, as well as in the greater, there are many appearances for which perhaps we ſhall never account; and many queſtions may be aſked, which no conjectures can thoroughly reſolve. It was the fault of the philoſophers of the laſt age, to be more inquiſitive after the cauſes of things, than after the things themſelves. They ſeemed to think that a confeſſion of ignorance cancelled their claims to wiſdom: they, therefore, had a ſolution for every demand. But the preſent age has grown, if not more inquiſitive, at leaſt more modeſt; and none are now aſhamed of that ignorance which labour can neither remedy nor remove.

CHAP. XI.

Of the Appearance of New ISLANDS, and TRACTS; and of the diſappearing of others.

HITHERTO we have taken a ſurvey only of the evils which are produced by ſubterranean fires, but we have mentioned nothing of the benefits they may poſſibly produce. They may be of uſe in warming and cheriſhing the ground, in promoting vegetation, and giving a more exquiſite flavour to the productions of the earth. The imagination of a perſon who has never been out of our own mild region, can ſcarcely reach to that luxuriant beauty with which all Nature appears cloathed in thoſe very countries that we have but juſt now deſcribed as deſolated by earthquakes, and undermined by ſubterranean fires. It muſt be granted, therefore, that though in thoſe regions they have a greater ſhare in the dangers, they have alſo a larger proportion in the benefits of Nature.

But there is another advantage ariſing from ſubterranean fires, which, though hitherto diſregarded by man, yet may one day become ſerviceable to him; namely, that while they are found to ſwallow up cities and plains in one place, they are alſo know to produce promontories and iſlands in another. We have many inſtances of iſlands being thus formed in the midſt of the ſea, which though for a long time barren, have afterwards become fruitful ſeats of happineſs and induſtry.

New iſlands are formed in two ways; either ſuddenly, by the action of ſubterraneous fires; or more ſlowly, by the depoſition of mud, carried down by rivers, and ſtopped by ſome accident. With reſpect particularly to the firſt, ancient hiſtorians, and modern travellers, give us ſuch accounts as we can have no room to doubt of. Seneca aſſures us, that in his time the iſland of Theraſia appeared unexpectedly to ſome mariners, as they were employed in another purſuit. Pliny aſſures us, that thirteen iſlands in the Mediterranean appeared at once emerging from the water; the cauſe of which he aſcribes rather to the retiring of the ſea in thoſe parts, than to any ſubterraneous elevation. However, he mentions the iſland of Hiera, near that of Theraſia, as formed by ſubterraneous exploſions; and adds to his liſt ſeveral others, formed in the ſame manner. In one of which he relates that fiſh in great abundance were found, and that all thoſe who eat of them died ſhortly after.

"On the twenty-fourth of May, in the year 1707, a ſlight earthquake was perceived at Santorin; and the day following, at ſun-riſing, an object was ſeen by the inhabitants of that iſland, at two or three miles diſtant at ſea, which appeared like a floating rock. Some perſons, deſirous either of gain or excited by curioſity, went there, and found, even while they ſtood upon this rock, that it ſeemed to riſe beneath their feet. They perceived alſo that its ſurface was covered with pumice ſtones and oyſters, which it had raiſed from the bottom. Every day after, until the fourteenth of June, this rock ſeemed conſiderably to increaſe; and then was found to be half a mile round, and about thirty feet above the ſea. The earth of which it was compoſed ſeemed whitiſh, with a ſmall portion of clay. Soon after this the ſea again appeared troubled, and ſteams aroſe, which were very offenſive to the inhabitants of Santorin. But on the ſixteenth of the ſucceeding month, ſeventeen or eighteen rocks more were ſeen to riſe out of the ſea, and at length to join together. All this was accompanied with the moſt terrible noiſe, and fires which proceeded from the iſland that was newly formed. The whole maſs, however, of all this new-formed earth, uniting, increaſed every day, both in height and breadth, and, by

by the force of its explosions, cast forth rocks to seven miles distance. This continued to bear the same dreadful appearances till the month of November in the same year; and it is at present a volcano which sometimes renews its explosions. It is about three miles in circumference; and more than from thirty-five to forty feet high."

It seems extraordinary, that about this place in particular, islands have appeared at different times, particularly that of Hiera, mention above, which has received considerable additions in succeeding ages. Justin tells us, that at the time the Macedonians were at war with the Romans, a new island appeared between those of Therameries and Therasia, by means of an earthquake. We are told, that this became half as big again about a thousand years after; another island rising up by its side, and joining to it, so as scarce at present to be distinguished from the former.

A new island was formed, in the year 1720, near that of Tercera, near the continent of Africa, by the same causes. In the beginning of December, at night, there was a terrible earthquake at that place, and the top of a new island appeared, which cast forth smoke in vast quantities. The pilot of a ship, who approached it, sounded on one side of this island, and could not find ground at sixty fathom. At the other side the sea was totally tinged of a different colour, exhibiting a mixture of white, blue, and green; and was very shallow. This island, on its first appearance, was larger than it is at present; for it has, since that time, sunk in such a manner, as to be scarce above water.

A traveller, whom these appearances could not avoid affecting, speaks of them in this manner: "What can be more surprising than to see fire not only break out of the bowels of the earth, but also to make itself a passage through the waters of the sea! What can be more extraordinary or foreign to our common notions of things, than to see the bottom of the sea rise up into a mountain above the water, and become so firm an island as to be able to resist the violence of the greatest storms! I know that subterraneous fires, when pent in a narrow passage, are able to raise up a mass of earth as large as an island. But that this should be done in so regular and exact a manner, that the water of the sea should not be able to penetrate and extinguish those fires; that, after having made so many passages, they should retain force enough to raise the earth; and, in fine, after having been extinguished, that the mass of earth should not fall down, or sink again with its own weight, but still remain in a manner suspended over the great arch below! This is what to me seems more surprising than any thing that has been related of Mount Ætna, Vesuvius, or any other volcano."

Such are his sentiments; however, there are few of these appearances any way more extraordinary than those attending volcanoes and earthquakes in general. We are not more to be surprised that inflammable substances should be found beneath the bottom of the sea, than at similar depths at land. These have all the force of fire giving expansion to air, and tending to raise the earth at the bottom of the sea, till it at length heaves above water. These marine volcanoes are not so frequent; for, if we may judge of the usual procedure of Nature, it must very often happen that, before the bottom of the sea is elevated above the surface, a chasm is opened in it, and then the water pressing in, extinguishes the volcano before it has time to produce its effects. This extinction, however, is not effected without very great resistance from the fire beneath. The water, upon dashing into the cavern, is very probably at first ejected back with great violence; and thus some of those amazing water-spouts are seen, which have so often astonished the mariner, and excited curiosity.——But of these in their place.

Besides the production of those islands by the action of fire, there are others, as was said, produced by rivers or seas carrying mud, earth, and such like substances, along with their currents; and at last depositing them in some particular place. At the mouths of most great rivers, there are to be seen banks, thus formed by the sand and mud carried down with the stream, which have rested at that place, where the force of the current is diminished by its junction with the sea. These banks, by slow degrees, increase at the bottom of the deep; the water in those places, is at first found by mariners to grow more shallow; the bank soon heaves up above the surface; it is considered, for a while, as a tract of useless and barren sand; but the seeds of some of the more hardy vegetables are driven thither by the wind, take root, and thus binding the sandy surface, the whole spot is cloathed in time with a beautiful verdure. In this manner there are delightful and inhabited islands at the mouths of many rivers, particularly the Nile, the Po, the Mississippi, the Ganges, and the Senegal. There has been, in the memory of man, a beautiful and large island formed in this manner, at the mouth of the river Nanquin, in China, made from depositions of mud at its opening: it is not less than sixty miles long, and about twenty broad. La Loubere informs us, in his voyage to Siam, that these sand-banks increase every day, at the mouths of all the great rivers in Asia; and hence he asserts, that the navigation up these rivers becomes every day more difficult; and will, at one time or another, be totally obstructed. The same may be remarked with regard to the Wolga, which has at present seventy openings into the Caspian sea; and of the Danube, which has seven into the Euxine. We have had an instance of the formation of a new island, not very long since, at the mouth of the Humber, in England. "It is yet within the memory of man," says the relator, "since it began to raise its head above the ocean. It began its appearance at low water, for the space of a few hours; and was buried again till the next tide's retreat. Thus, successively, it lived and died, until the year 1666, when it began to maintain its ground against the insult of the waves; and then first invited the aid of human industry. A bank was thrown about its rising grounds; and being thus defended from the incursions of the sea, it became firm and solid, and, in a short time, afforded good pasturage for cattle. It is about nine miles in circumference, and is worth to the propietor about eight hundered pounds a year." It would be endless to mention all the islands that have been thus formed, and the advantages that have been derived from them. However, it is frequently found, that new islands may often be considered as only turning the rivers from their former beds; so that, in proportion as land is gained at one part, it is lost by the overflowing of some other.

Little, therefore, is gained by such accessions; nor is there much more by the new islands which are sometimes formed from the spoils of the continent. Mariners assure us, that there are sometimes whole plains unrooted from the main lands, by floods and tempests. These being carried out to sea, with all their trees and animals upon them, are frequently seen floating in the ocean, and exhibiting a surprizing appearance of rural tranquillity in the midst of danger. The greatest part, however, having the earth at their roots at length washed away, are dispersed, and their animals drowned; but now and then some are found to brave the fury of the ocean, till being stuck either among rocks or sands, they again take firm footing, and become permanent islands.

As different cauſes have thus concurred to produce new iſlands, ſo we have accounts of others that the ſame cauſes have contributed to deſtroy. We have already ſeen the power of earthquakes exerted in ſinking whole cities, and leaving lakes in their room. There have been iſlands, and regions alſo, that have ſhared the ſame fate; and have ſunk with their inhabitants, never more to be heard of. Thus Pauſanias tells us of an iſland, called Chryſes, that was ſunk near Lemnos. Pliny mentions ſeveral; among others, the iſland of Cea, for thirty miles, having been waſhed away, with ſeveral thouſands of its inhabitants. But of all the noted devaſtations of this kind, the total ſubmerſion of the iſland of Atalantis, as mentioned by Plato, has been moſt the ſubject of ſpeculation. Mankind, in general, now conſider the whole of his account as an ingenious fable; but when fables are grown famous by time and authority, they become an agreeable, if not a neceſſary part of literary information.

"About nine thouſand years are paſſed," ſays Plato, "ſince the iſland of Atalantis was in being. The prieſts of Egypt were well acquainted with it; and the firſt heroes of Athens gained much glory in their wars with the inhabitants. This iſland was as large as Aſia Minor and Syria united; and was ſituated beyond the pillars of Hercules, in the Atlantic ocean. The beauty of the buildings, and the fertility of the ſoil, were far beyond any thing a modern imagination can conceive; gold and ivory were every where common; and the fruits of the earth offered themſelves without cultivation. The arts, and the courage of the inhabitants, were not inferior to the happineſs of their ſituation; and they were frequently known to make conqueſts, and over-run the continent of Europe and Aſia. The imagination of the poetical philoſopher riots in the deſcription of the natural and acquired advantages, which they long enjoyed in this charming region. If, ſays he, we compare that country to our own, ours will appear a mere waſted ſkeleton, when oppoſed to it. Their mountains to the very tops were cloathed with fertility, and poured down rivers to enrich the plains below."

However, all theſe beauties and benefits were deſtroyed in one day by an earthquake ſinking the earth, and the ſea overwhelming it. At preſent, not the ſmalleſt veſtiges of ſuch an iſland are to be found; Plato remains as the only authority for its exiſtence; and philoſophers diſpute about its ſituation. However, we do not mean to enter into the controverſy, as there appears but little probability to ſupport the fact; and, indeed, it would be uſeleſs to run back nine thouſand years in ſearch of difficulties, as we are ſurrounded with objects that more cloſely affect us, and that demand admiration at our very doors. When we conſider, as Lactantius ſuggeſts, the various viciſſitudes of nature; lands ſwallowed by yawning earthquake, or overwhelmed in the deep; rivers and lakes diſappearing, or dried away; mountains levelled into plains; and plains ſwelling up into mountains; we cannot help regarding this earth as a place of very little ſtability: as a tranſient abode of ſtill more tranſitory beings.

CHAP. XII.

Of MOUNTAINS.

HAVING at laſt, in ſome meaſure, emerged from the deeps of the earth, we come to a ſcene of greater ſplendour; the contemplation of its external appearance. In this ſurvey, its mountains are the firſt objects that ſtrike the imagination, and excite our curioſity. There is not, perhaps, any thing in all nature that impreſſes an unaccuſtomed ſpectator with ſuch ideas of awful ſolemnity, as theſe immenſe piles of Nature's erecting, that ſeem to mock the minuteneſs of human magnificence.

In countries where there are nothing but plains, the ſmalleſt elevations are apt to excite wonder. In Holland, which is all a flat, they ſhew a little ridge of hills, near the ſea-ſide, which Boerhaave generally marked out to his pupils, as being mountains of no ſmall conſideration. What would be the ſenſations of ſuch an auditory, could they at once be preſented with a view of the heights and precipices of the Alps, or the Andes! Even among us, in England, we have no adequate ideas of a mountain-proſpect; our hills are generally ſloping from the plain, and cloathed to the very top with verdure; we can ſcarce, therefore, lift our imaginations to thoſe immenſe piles whoſe tops peep up behind intervening clouds, ſharp and precipitate, and reach to heights that human avarice or curioſity have never been able to aſcend.

We, in this part of the world, are not, for that reaſon, ſo immediately intereſted in the queſtion which has ſo long been agitated among philoſophers, concerning what gave riſe to theſe inequalities on the ſurface of the globe. In our own happy region, we generally ſee no inequalities but ſuch as contribute to uſe and beauty; and we, therefore, are amazed at a queſtion enquiring how ſuch neceſſary inequalities came to be formed, and ſeeming to expreſs a wonder how the globe comes to be ſo beautiful as we find it. But though with us there may be no great cauſe for ſuch a demand, yet in thoſe places where mountains deform the face of Nature, where they pour down cataracts, or give fury to tempeſts, there ſeems to be good reaſon for enquiry either into their cauſes or their uſes. It has been, therefore, aſked by many, in what manner mountains have come to be formed; or for what uſes they are deſigned?

To ſatisfy curioſity in theſe reſpects, much reaſoning has been employed, and very little knowledge propagated. With regard to the firſt part of the demand, the manner in which mountains were formed, we have already ſeen the conjectures of different philoſophers on that head. One ſuppoſing that they were formed from the earth's broken ſhell, at the time of the deluge: another, that they exiſted from the creation, and only acquired their deformities in proceſs of time: a third, that they owed their original to earthquakes: and ſtill a fourth, with much more plauſibility than the reſt, aſcribing them entirely to the fluctuations of the deep, which he ſuppoſes in the beginning to have covered the whole earth. Such as are pleaſed with diſquiſitions of this kind, may conſult Burnet, Whiſton, Woodward, or Buffon. Nor would we be thought to decry any mental amuſements, that at worſt keep us innocently employed; but we cannot help wondering how the oppoſite demand has never come to be made; and why philoſophers have never aſked how we come to have plains? Plains are ſometimes more prejudicial to man than mountains. Upon plains, an innundation has greater power; the beams of the ſun are often collected there with ſuffocating fierceneſs; they are ſometimes found deſert for ſeveral hundred miles together, as in the country eaſt of the Caſpian ſea, although otherwiſe fruitful, merely becauſe there are no riſings nor depreſſions to form reſervoirs, or collect the ſmalleſt rivulet of water. The moſt rational anſwer, therefore, why either mountains or plains were formed, ſeems to be, that they were thus faſhioned by the hand of Wiſdom, in order that pain and pleaſure ſhould be ſo contiguous, as that morality might be exerciſed either in bearing the one, or communicating the other.

Indeed, the more we conſider this diſpute reſpecting

ſpecting the formation of mountains, the more we are ſtruck with the futility of the queſtion. There is neither a ſtrait line, nor an exact ſuperficies, in all nature. If we conſider a circle, even with mathematical preciſion, we ſhall find it formed of a number of ſmall right lines, joining at angles together. Theſe angles, therefore, may be conſidered in a circle as mountains are upon our globe; and to demand the reaſon for the one being mountainous, or the other angular, is only to aſk why a circle is a circle, or a globe is a globe. In ſhort, if there be no ſurface without inequality in Nature, why ſhould we be ſurpriſed that the earth has ſuch? It has often been ſaid, that the inequalities of its ſurface are ſcarce diſtinguiſhable, if compared to its magnitude; and indeed we have every reaſon to be content with the anſwer.

Some, however, have avoided the difficulty by urging the final cauſe. They alledge that mountains have been formed merely becauſe they are uſeful to man. This carries the enquirer but a part of the way; for no one can affirm that in all places they are uſeful. The contrary is known, by horrid experience, in thoſe valleys that are ſubject to their influence. However, as the utility of any part of our earthly habitation, is a very pleaſing and flattering ſpeculation to every philoſopher, it is not to be wondered that much has been ſaid to prove the uſefulneſs of theſe. For this purpoſe, many conjectures have been made that have received a degree of aſſent even beyond their evidence; for men were unwilling to become more miſerably wiſe.

It has been alledged, as one principal advantage that we derive from them, that they ſerve, like hoops or ribs, to ſtrengthen our earth, and to bind it together. In conſequence of this theory, Kircher has given us a map of the earth, in this manner hooped with its mountains; which might have a much more ſolid foundation, did it entirely correſpond with truth.

Others have found a different uſe for them, eſpecially when they run ſurrounding our globe; which is, that they ſtop the vapours which are continually travelling from the equator to the poles; for theſe being urged by the heat of the ſun, from the warm regions of the line, muſt all be accumulated at the poles, if they were not ſtopped in their way by thoſe high ridges of mountains which croſs their direction. But an anſwer to this may be, that all the great mountains in America lie lengthwiſe, and therefore do not croſs their direction.

But to leave theſe remote advantages, others aſſert, that not only the animal but vegetable part of the creation would periſh for want of convenient humidity, were it not for their friendly aſſiſtance. Their ſummits are, by theſe, ſuppoſed to arreſt, as it were, the vapours which float in the regions of the air. The large inflexions, and channels, are conſidered as ſo many baſons prepared for the reception of thoſe thick vapours, and impetuous rains, which deſcend into them. The huge caverns beneath are ſo many magazines or conſervatories of water for the peculiar ſervice of man: and thoſe orifices by which the water is diſcharged upon the plain, are ſo ſituated as to enrich and render them fruitful, inſtead of returning through ſubterraneous channels to the ſea, after the performance of a tedious and fruitleſs circulation.

However this be, certain it is that almoſt all our great rivers find their ſource among mountains; and, in general, the more extenſive the mountain, the greater the river: thus the river Amazons, the greateſt in the world, has its ſource among the Andes, which are the higheſt mountains on the globe; the river Niger travels a long courſe of ſeveral hundred miles from the mountains of the Moon, the higheſt in all Africa; and the Danube and the Rhine proceed from the Alps, which are probably the higheſt mountains of Europe.

It need ſcarce be ſaid that, with reſpect to height, there are many ſizes of mountains, from the gently riſing upland, to the tall craggy precipice. The appearance is in general different in thoſe of different magnitudes. The firſt are cloathed with verdure to the very tops, and only ſeem to aſcend to improve our proſpects, or ſupply us with a purer air: but the lofty mountains of the other claſs have a very different aſpect. At a diſtance their tops are ſeen, in wavy ridges, of the very colour of the clouds, and only to be diſtinguiſhed from them by their figure, which, as we have ſaid, reſemble the billows of the ſea. As we approach, the mountain aſſumes a deeper colour; it gathers upon the ſky, and ſeems to hide half the horizon behind it. Its ſummits alſo are become more diſtinct, and appear with a broken and perpendicular line. What at firſt ſeemed a ſingle hill, is now found to be a chain of continued mountains, whoſe tops running along in ridges, are emboſomed in each other: ſo that the curvatures of one are fitted to the prominences of the oppoſite ſide, and form a winding valley between, often of ſeveral miles in extent; and all the way continuing nearly of the ſame breadth.

Nothing can be finer, or more exact, than Mr. Pope's deſcription of a traveller ſtraining up the Alps. Every mountain he comes to, he thinks will be the laſt; he finds, however, an unexpected hill riſe before him; and that being ſcaled, he finds the higheſt ſummit almoſt at as great a diſtance as before. Upon quitting the plain, he might have left a green and a fertile ſoil, and a climate warm and pleaſing. As he aſcends, the ground aſſumes a more ruſſet colour; the graſs becomes more moſſy, and the weather more moderate. Still as he aſcends, the weather becomes more cold, and the earth more barren. In this dreary paſſage, he is often entertained with a little valley of ſurpriſing verdure, cauſed by the reflected heat of the ſun collected into a narrow ſpot on the ſurrounding heights. But it much more frequently happens that he ſees only frightful precipices beneath, and lakes of amazing depths; from whence rivers are formed, and fountains derive their original. On thoſe places next the higheſt ſummits, vegetation is ſcarcely carried on; here and there a few plants of the moſt hardy kind appear. The air is intolerably cold; either continually refrigated with froſts, or diſturbed with tempeſts. All the ground here wears an eternal covering of ice, and ſnows that ſeem conſtantly accumulating. Upon emerging from this war of the elements, he aſcends into a purer and a ſerener region, where vegetation is entirely ceaſed; where the precipices, compoſed entirely of rocks, riſe perpendicularly above him; while he views beneath him all the combat of the elements; clouds at his feet; and thunders darting upward from their boſoms below. A thouſand meteors, which are never ſeen on the plain, preſent themſelves. Circular rainbows; mock ſuns; the ſhadow of the mountain projected upon the body of the air; and the traveller's own image, reflected as in a looking-glaſs, upon the oppoſite cloud.

Such are, in general, the wonders that preſent themſelves to a traveller in his journey either over the Alps or the Andes. But we muſt not ſuppoſe that this picture exhibits either a conſtant or an invariable likeneſs of thoſe ſtupendous heights. Indeed, nothing can be more capricious or irregular than the forms of many of them. The tops of ſome run in ridges for a conſiderable length, without interruption; in others, the line ſeems indented by great valleys to an amazing depth. Sometimes a ſolitary and a ſingle mountain riſes from the boſom of the plain; and ſometimes extenſive plains, and even provinces,

provinces, as thoſe of Savoy and Quito, are found emboſomed near the tops of mountains. In general, however, thoſe countries that are moſt mountainous, are the moſt barren and uninhabitable.

If we compare the heights of mountains with each other, we ſhall find that the greateſt and higheſt are found under the Line. It is thought by ſome, that the rapidity of the earth's motion in theſe parts, together with the greatneſs of the tides there, may have thrown up thoſe ſtupendous maſſes of earth. But, be the cauſe as it may, it is a remarkable fact, that the inequalities of the earth's ſurface are greateſt there. Near the Poles, the earth, indeed, is craggy and uneven enough; but the heights of the mountains there are very inconſiderable. On the contrary, at the Equator, where Nature ſeems to ſport in the amazing ſize of all her productions, the plains are extenſive; and the mountains remarkably lofty. Some of them are known to riſe three miles perpendicular above the bed of the ocean.

To enumerate the moſt remarkable of theſe, according to their ſize, we ſhall begin with the Andes, of which we have an excellent deſcription by Ulloa, who went thither by command of the king of Spain, in company with the French Academicians, to meaſure a degree of the meridian. His journey up theſe mountains is too curious not to give an extract from.

After many incommodious days ſailing up the river Guayaquil, he arrived at Caracol, a town ſituated at the foot of the Andes. Nothing could exceed the inconveniences which he experienced in this voyage, from the flies and moſchettoes (an animal reſembling our gnat).

"We were the whole day," ſays he, "in continual motion to keep them off; but at night our torments were exceſſive. Our gloves, indeed, were ſome defence to our hands; but our faces were entirely expoſed; nor were our cloaths a ſufficient defence for the reſt of our bodies; for their ſtings penetrating through the cloth, cauſed a very painful and fiery itching. One night, in coming to an anchor near a large and handſome houſe that was uninhabited, we had no ſooner ſeated ourſelves in it, than we were attacked on all ſides by ſwarms of moſchettoes, ſo that it was impoſſible to have one moment's quiet. Thoſe who had covered themſelves with cloaths made for this purpoſe, found not the ſmalleſt defence; wherefore, hoping to find ſome relief in the open fields, they ventured out, though in danger of ſuffering in a more terrible manner from the ſerpents. But both places were equally obnoxious. On quitting this inhoſpitable retreat, we the next night took up our quarters in a houſe that was inhabited; the hoſt of which being informed of the terrible manner we had paſſed the night before, he gravely told us, that the houſe we ſo greatly complained of, had been forſaken on account of its being the purgatory of a ſoul. But we had more reaſon to believe that it was quitted on account of its being the purgatory of the body. After having journeyed for upwards of three days, through boggy roads, in which the mules at every ſtep ſunk up to their bellies, we began at length to perceive an alteration in the climate; and having been long accuſtomed to heat, we now began to feel it grow ſenſibly colder.

"It is remarkable, that at Tariguagua we often ſee inſtances of the effects of two oppoſite temperatures, in two perſons happening to meet; one of them leaving the plains below, and the other deſcending from the mountain. The former thinks the cold ſo ſevere, that he wraps himſelf up in all the garments he can procure; while the latter, finds the heat ſo great, that he is ſcarce able to bear any cloaths whatſoever. The one thinks the water ſo cold, that he avoids being ſprinkled by it; the other is ſo delighted with its warmth, that he uſes it as a bath. Nor is the caſe very different in the ſame perſon, who experiences the ſame diverſity of ſenſation upon his journey up, and upon his return. This difference only proceeds from the change naturally felt at leaving a climate to which one has been accuſtomed, and coming into another of an oppoſite temperature.

"The ruggedneſs of the road from Tariguagua, leading up the mountain, is not eaſily deſcribed. In ſome parts, the declivity is ſo great, that the mules can ſcarce keep their footing; and in others, the acclivity is equally difficult. The trouble of having people going before to mend the road, the pains ariſing from the many falls and bruiſes, and the being conſtantly wet to the ſkin, might be ſupported, were not theſe inconveniencies augmented by the ſight of ſuch frightful precipices, and deep abyſſes, as muſt fill the mind with ceaſeleſs terror. There are ſome places where the road is ſo ſteep, and yet ſo narrow, that the mules are obliged to ſlide down, without making any uſe of their feet whatſoever. On one ſide of the rider, in this ſituation, riſes an eminence of ſeveral hundred yards; and on the other, an abyſs of equal depth; ſo that if he in the leaſt checks his mule, ſo as to deſtroy the equilibrium, they both muſt unavoidably periſh.

"After having travelled about nine days in this manner, ſlowly winding along the ſide of the mountain, we began to find the whole country covered with an hoar froſt; and an hut in which we lay had ice on it. Having eſcaped many perils, we at length, after a journey of fifteen days, arrived upon the plain, on the extremity of which ſtands the city of Quito, the capital of one of the moſt charming regions upon earth. Here, in the centre of the torrid zone, the heat is not only very tolerable, but in ſome places the cold alſo is painful. Here they enjoy all the temperature and advantages of perpetual ſpring; their fields being always covered with verdure, and enamelled with flowers of the moſt lively colours. However, although this beautiful region be higher than any other country in the world, and although it took up ſo many days of painful journey in the aſcent, it is ſtill overlooked by tremendous mountains; their ſides covered with ſnow, and yet flaming with volcanoes at the top. Theſe ſeemed piled one upon the other, and riſe to a moſt aſtoniſhing height, with great coldneſs. However, at a determined point above the ſurface of the ſea, the congelation is found at the ſame height in all the mountains. Thoſe parts which are not ſubject to a continual froſt, have here and there growing upon them a ruſh, reſembling the geniſta, but much more ſoft and flexible. Towards the extremity of the part where the ruſh grows, and the cold begins to increaſe, is found a vegetable, with a round bulbous head, which, when dried, becomes of amazing elaſticity. Higher up the earth is entirely bare of vegetation, and ſeems covered with eternal ſnow. The moſt remarkable mountains are, that of Cotopaxi, (already deſcribed as a volcano) Chimborazo, and Pichincha; Cotopaxi is more than three geographical miles above the ſurface of the ſea: the reſt are not much inferior. On the top of the latter was my ſtation for meaſuring a degree of the meridian; where I ſuffered particular hardſhips, from the intenſeneſs of the cold, and the violence of the ſtorms. The ſky around was, in general, involved in thick fogs, which, when they cleared away, and the clouds, by their gravity, moved nearer to the ſurface of the earth, they appeared ſurrounding the foot of the mountain, at a vaſt diſtance below, like a ſea, encompaſſing an iſland in the midſt of it. When this happened, the horrid noiſes of tempeſts were heard from beneath, then diſcharging themſelves

ſelves on Quito, and the neighbouring country. I ſaw the lightenings iſſue from the clouds, and heard the thunders roll far beneath me. All this time, while the tempeſt was raging below, the mountain top, where I was placed, enjoyed a delightful ſerenity; the wind was abated; the ſky clear; and the enlivening rays of the ſun moderated the ſeverity of the cold. However, this was of no very long duration, for the wind returned with all its violence, and with ſuch velocity as to dazzle the ſight; whilſt my fears were increaſed by the dreadful concuſſions of the precipice, and the fall of enormous rocks; the only ſounds that were heard in this frightful ſituation."

Such is the animated picture of theſe mountains, as given us by this ingenious Spaniard. A paſſage over the Alps, or a journey acroſs the Pyrenees, appear petty trips or excurſions, in the compariſon; and yet theſe are the moſt lofty mountains we know of in Europe.

If we compare the Alps with the mountains already deſcribed, we ſhall find them but little more than one half of the height of the former. The Andes, upon being meaſured by the barometer, are found above three thouſand one hundred and thirty-ſix toiſes or fathoms above the ſurface of the ſea. Whereas the higheſt point of the Alps is not above ſixteen hundred. The one, in other words, is above three miles high; the other, about a mile and a half. The higheſt mountains in Aſia are, Mount Taurus, Mount Immaus, Mount Caucaſus, and the mountains of Japan.—Of theſe, none equals the Andes in height; although Mount Caucaſus, which is the higheſt of them, makes very near approaches. Father Verbieſt tells of a mountain in China, which he meaſured, and found a mile and a half high. In Africa, the mountains of the Moon, famous for giving ſource to the Niger, and the Nile, are rather more noted than known. Of the Pike of Teneriffe, one of the Canary Iſlands that lie off this coaſt, we have more certain information. In the year 1727, it was viſited by a company of Engliſh merchants, who travelled up to the top, where they obſerved its height, and the volcano on its very ſummit. They found it an heap of mountains, the higheſt of which riſes over the reſt like a ſugar-loaf, and gives a name to the whole maſs. It is computed to be a mile and a half perpendicular from the ſurface of the ſea. Kircher gives us an eſtimate of the heights of moſt of the other great mountains in the world; but as he has taken his calculations, in general, from the ancients, or from modern travellers, who had not the art of meaſuring them, they are quite incredible. The art of taking the heights of places by the barometer, is a new, and an ingenious invention. As the air grows lighter as we aſcend, the fluid in the tube riſes in due proportion; thus the inſtrument being properly marked, gives the height with a tolerable degree of exactneſs; at leaſt enough to ſatisfy curioſity.

Few of our great mountains have been eſtimated in this manner; travellers having, perhaps, been deterred, by a ſuppoſed impoſſibility of breathing at the top. However, it has been invariably found, that the air in the higheſt that our modern travellers have aſcended, is not at all too fine for reſpiration. At the top of the Pike of Teneriffe, there was found no other inconvenience from the air, except its coldneſs; at the top of the Andes there was no difficulty of breathing perceived. The accounts, therefore, of thoſe who have aſſerted that they were unable to breathe, although at much leſs heights, are greatly to be ſuſpected. In fact, it is very natural for mankind to paint thoſe obſtacles as inſurmountable, which they themſelves have not had the fortitude or perſeverance to ſurmount.

The difficulty and danger of aſcending to the tops of mountains, proceeds from other cauſes, not the thinneſs of the air. For inſtance, ſome of the ſummits of the Alps have never yet been viſited by man; but the reaſon is, that they riſe with ſuch a rugged and precipitate aſcent, that they are utterly inacceſſible. In ſome places they appear like a great wall of ſix or ſeven hundred feet high; in others, there ſtick out enormous rocks, that hang upon the brow of the ſteep, and every moment threaten deſtruction to the traveller below.

In this manner almoſt all the tops of the higheſt mountains are bare and pointed. And this naturally proceeds from their being ſo continually aſſaulted by thunders and tempeſts. All the earthy ſubſtances with which they might have been once covered, have for ages been waſhed away from their ſummits; and nothing is left remaining, but immenſe rocks, which no tempeſt has hitherto been able to deſtroy.

Nevertheleſs, time is every day, and every hour, making depredations; and huge fragments are ſeen tumbling down the precipice, either looſed from the ſummit by froſt or rains, or ſtruck down by lightening. Nothing can exhibit a more terrible picture than one of theſe enormous rocks, commonly larger than an houſe, falling from its height, with a noiſe louder than thunder, and rolling down the ſide of the mountain. Doctor Plot tells us of one in particular, which being looſened from its bed, tumbled down the precipice, and was partly ſhattered into a thouſand pieces. Notwithſtanding, one of the largeſt fragments of the ſame, ſtill preſerving its motion, travelled over the plain below, croſſed a rivulet in the midſt, and at laſt ſtopped on the other ſide of the bank! Theſe fragments, as was ſaid, are often ſtruck off by lightening, and ſometimes undermined by rains; but the moſt uſual manner in which they are diſunited from the mountain, is by froſt: the rains inſinuating between the interſtices of the mountain, continue there until there comes a froſt, and then, when converted into ice, the water ſwells with an irreſiſtible force, and produces the ſame effect as gun-powder, ſplitting the moſt ſolid rocks, and thus ſhattering the ſummits of the mountain.

But not rocks alone, but whole mountains are, by various cauſes, diſunited from each other. We ſee, in many parts of the Alps, amazing clefts, the ſides of which ſo exactly correſpond with the oppoſite, that no doubt can be made of their having been once joined together. At Cajeta, in Italy, a mountain was ſplit in this manner by an earthquake; and there is a paſſage opened through it, that appears as if elaborately done by the induſtry of man. In the Andes theſe breaches are frequently ſeen. That at Thermopyle, in Greece, has been long famous. The mountain of the Troglodytes, in Arabia, has thus a paſſage through it: and that in Savoy, which Nature began, and which Victor Amadeus completed, is an inſtance of the ſame kind.

We have accounts of ſome of theſe diſruptions, immediately after their happening. In the month of June, in the year 1714, a part of the mountain of Diableret, in the diſtrict of Valais, in France, ſuddenly fell down, between two and three o'clock in the afternoon, the weather being very calm and ſerene. It was of a conical figure, and deſtroyed fifty-five cottages in the fall. Fifteen perſons, together with about an hundred beaſts, were alſo cruſhed beneath its ruins, which covered an extent of a good league ſquare. The duſt it occaſioned, inſtantly covered all the neighbourhood in darkneſs. The heaps of rubbiſh were more than three hundred feet high. They ſtopped the current of a river that ran along the plain, which is now formed into ſeveral new and deep lakes. There appeared, through the whole of this rubbiſh, none of thoſe

ſubſtances that ſeemed to indicate that this diſruption had been made by means of ſubterraneous fires. Moſt probably, the baſe of this rocky mountain was rotted and decayed; and thus fell without any extraneous violence. In the ſame manner, in the year 1618, the town of Pleurs, in France, was buried beneath a rocky mountain, at the foot of which it was ſituated.

Theſe accidents, and many more that might be enumerated of the ſame kind, have been produced by various cauſes: by earthquakes, as in the mountain at Cajota; or by being decayed at the bottom, as at Diableret. But the moſt general way is, by the foundation of one part of the mountain being hollowed by waters, and, thus wanting a ſupport, breaking from the other. Thus it generally has been found in the great chaſms in the Alps; and thus it almoſt always is known in thoſe diſruptions of hills, which are known by the name of land-ſlips. Theſe are nothing more than the ſlidings down of an higher piece of ground, diſrooted from its ſituation by ſubterraneous inundations, and ſettling itſelf upon the plain below.

There is not an appearance in all nature that ſo much aſtoniſhed our anceſtors, as theſe land-ſlips. In fact, to behold a large upland, with its houſes, its corn, and cattle, at once looſened from its place, and floating, as it water, upon the ſubjacent water; to behold it quitting its ancient ſituation, and travelling forward like a ſhip, in queſt of new adventures; this is certainly one of the moſt extraordinary appearances that can be imagined; and to a people, ignorant of the powers of Nature, might well be conſidered as a prodigy. Accordingly, we find all our old hiſtorians mentioning it as an omen of approaching calamities. In this more enlightened age, however, its cauſe is very well known; and, inſtead of exciting ominous apprehenſions in the populace, it only gives riſe to ſome very ridiculous law-ſuits among them, about whoſe the property ſhall be; whether the land which has thus ſlipt, ſhall belong to the original poſſeſſor, or to him upon whoſe grounds it has encroached and ſettled. What has been the determination of the judges, is not ſo well known; but the circumſtances of the ſlips have been minutely and exactly deſcribed.

In the lands of Slatberg, in the kingdom of Iceland, there ſtood a declivity, gradually aſcending for near half a mile. In the year 1713, and on the 10th of March, the inhabitants perceived a crack on its ſide, ſomewhat like a furrow made with a plough, which they imputed to the effects of lightening, as there had been thunder the night before. However, on the evening of the ſame day, they were ſurpriſed to hear an hideous confuſed noiſe iſſuing all round from the ſide of the hill; and their curioſity being raiſed, they reſorted to the place. There, to their amazement, they found the earth, for near five acres, all in gentle motion, and ſliding down the hill upon the ſubjacent plain. This motion continued the remaining part of the day, and the whole night; nor did the noiſe ceaſe during the whole time; proceeding, probably, from the attrition of the ground beneath. The day following, however, this ſtrange journey down the hill ceaſed entirely; and above an acre of the meadow below was found covered with what before compoſed a part of the declivity.

However, theſe ſlips, when a whole mountain's ſide ſeems to deſcend, happen but very rarely. There are ſome of another kind, however, much more common; and, as they are always ſudden, much more dangerous. Theſe are ſnow-ſlips, well known, and greatly dreaded by travellers. It often happens, that when ſnow has long been accumulated on the tops and on the ſides of mountains, it is born down the precipice, either by means of tempeſts, or its own melting. At firſt, when looſened, the volume in motion is but ſmall, but gathers as it continues to roll; and, by the time it has reached the habitable parts of the mountain, is generally grown of enormous bulk. Wherever it rolls it levels all things in its way, or buries them in unavoidable deſtruction. Inſtead of rolling, it ſometimes is found to ſlide along from the top; yet even thus it is generally as fatal as before. Nevertheleſs, we have had an inſtance, a few years ago, of a ſmall family in Germany, that lived for above a fortnight beneath one of theſe ſnow-ſlips. Although they were buried, during that whole time, in utter darkneſs, and under a bed of ſome hundred feet deep, yet they were luckily taken out alive; the weight of the ſnow being ſupported by a beam that kept up the roof; and nouriſhment being ſupplied them by the milk of an aſs, that was buried under the ſame ruin.

But it is not the parts, alone, that are thus found to ſubſide, whole mountains have been known totally to diſappear. Pliny tells us, that in his own time, the lofty mountain of Cybotus, together with the city of Eurites, were ſwallowed by an earthquake. The ſame fate, he ſays, attended Phlegium, one of the higheſt mountains in Æthiopia; which, after one night's concuſſion, was never ſeen more. In more modern times, a very noted mountain in the Molucca iſlands, known by the name of the Peak, and remarkable for being ſeen at a very great diſtance from ſea was ſwallowed by an earthquake; and nothing but a lake was left in the place where it ſtood. Thus, while ſtorms and tempeſts are levelled againſt mountains above, earthquakes and waters are undermining them below! All our hiſtories talk of their deſtruction; and very few new ones (if we except Mount Cenere, and one or two ſuch heaps of cinders) are produced. If mountains, therefore, were of ſuch great utility as ſome philoſophers make them to mankind, it would be a very melancholy conſideration that ſuch benefits were diminiſhed every day. But the truth is, the valleys are fertilized by that earth which is waſhed from their ſides; and the plains become richer, in proportion as the mountains decay.

CHAP. XIII.

Of WATER.

IN contemplating nature, we ſhall often find the ſame ſubſtances poſſeſſed of contrary qualities, and producing oppoſite effects. Air, which liquifies one ſubſtance, dries up another. That fire which is ſeen to burn up the deſart, is often found, in other places, to aſſiſt the luxuriance of vegetation: and water, which, next to fire, is the moſt fluid ſubſtance upon earth, nevertheleſs, gives all other bodies their firmneſs and durability; ſo that every element ſeems to be a powerful ſervant, capable either of good or ill, and only awaiting external direction, to become the friend or the enemy of mankind. Theſe oppoſite qualities, in this ſubſtance in particular, have not failed to excite the admiration and enquiry of the curious.

That water is the moſt fluid, penetrating body, next to fire, and the moſt difficult to confine, is inconteſtibly proved by a variety of experiments. A veſſel through which water cannot paſs, may be ſaid to retain any thing. It may be objected, indeed, that ſyrups, oils, and honey, leak through ſome veſſels that water cannot paſs through; but this is far from being the reſult of the greater tenuity and fineneſs of their parts; it is owing to the roſin wherewith the wood of ſuch veſſels abounds, which oils and ſyrups have a power of diſſolving; ſo that theſe fluids, inſtead of finding their way, may more properly

properly be ſaid to eat their way through the veſſels that contain them. However, water will at laſt find its way even through theſe; for it is known to eſcape through veſſels of every ſubſtance, glaſs only excepted. Other bodies may be found to make their way out more readily indeed; as air, when it finds a vent, will eſcape at once; and quickſilver, becauſe of its weight, quickly penetrates through whatever chinky veſſel confines it: but water, though it operates more ſlowly, yet always finds a more certain iſſue. As, for inſtance, it is well known that air will not paſs through leather; which water will very readily penetrate. Air alſo may be retained in a bladder; but water will quickly ooze through. And thoſe who drive this to the greateſt degree of preciſion, pretend to ſay, that it will paſs through pores ten times ſmaller than air can do. Be this as it may, we are very certain that its parts are ſo ſmall that they have been actually driven through the pores of gold. This has been proved by the famous Florentine experiment, in which a quantity of water was ſhut up in an hollow ball of gold, and then preſſed with an huge force by ſcrews, during which the fluid was ſeen to ooze through the pores of the metal, and to ſtand, like a dew, upon its ſurface.

As water is thus penetrating, and its parts thus minute, it may eaſily be ſuppoſed that they enter into the compoſition of all bodies, vegetable, animal, and foſſil. This every chemiſt's experience convinces him of; and the mixture is the more obvious, as it can always be ſeparated, by a gentle heat, from thoſe ſubſtances with which it had been united. Fire, as was ſaid, will penetrate where water cannot paſs; but then it is not ſo eaſily to be ſeparated. But there is ſcarce any ſubſtance from which its water cannot be divorced. The parings or filings of lead, tin, and antimony, by diſtillation, yield water plentifully: the hardeſt ſtones, ſea-ſalt, nitre, vitriol, and ſulphur, are found to conſiſt chiefly of water; into which they reſolve by force of fire. "All birds, beaſts, and fiſhes," ſays Newton, "inſects, trees, and vegetables, with their parts grow frow water; and, by putrefaction, return to water again." In ſhort, almoſt every ſubſtance that we ſee, owes its texture and firmneſs to the parts of water that mix with its earth; and, deprived of this fluid, becomes a maſs of ſhapeleſs duſt and aſhes.

From hence we ſee, as was above hinted, that this moſt fluid body, when mixed with others, gives them conſiſtence and form. Water, by being mixed with earth or aſhes, and formed into a veſſel, when baked before the fire, becomes a copel, remarkable for this, that it will bear the utmoſt force of the hotteſt furnace that art can contrive. So the Chineſe earth, of which porcelane is made, is nothing more than an artificial compoſition of earth and water united by heat; and which a greater degree of heat could eaſily ſeparate. Thus we ſee a body, extremely fluid of itſelf, in ſome meaſure aſſuming a new nature, by being united with others; we ſee a body, whoſe fluid and diſſolving qualities are ſo obvious, giving conſiſtence and hardneſs to all the ſubſtances of the earth.

From conſiderations of this kind, Thales, and many of the ancient philoſophers, held that all things were made of water. In order to confirm this opinion, Helmont made an experiment, by diveſting a quantity of earth of all its oils and ſalts, and then putting this earth, ſo prepared, into an earthen pot, which nothing but rain-water could enter, and planting a willow therein; this vegetable, ſo planted, grew up to a conſiderable height and bulk, merely from the accidental aſperſion of rain-water; while the earth in which it was planted received no ſenſible diminution. From this experiment, he concluded, that water was the only nouriſhmen of the vegetable tribe; and that vegetables, being the nouriſhment of animals, all organized ſubſtances, therefore, owed their ſupport and being only to water. But this has been ſaid by Woodward to be a miſtake: for he ſhews, that water being impregnated with earthy particles, is only the conveyer of ſuch ſubſtances into the pores of vegetables, rather than an increaſer of them, by its own bulk: and likewiſe, that water is ever found to afford ſo much leſs nouriſhment, in proportion as it is purified by diſtillation. A plant in diſtilled water will not grow ſo faſt as in water not diſtilled: and if the ſame be diſtilled three or four times over, the plant will ſcarce grow at all, or receive any nouriſhment from it. So that water, as ſuch, does not ſeem the proper nouriſhment of vegetables, but only the vehicle thereof, which contains the nutritious particles, and carries them through all parts of the plants. Water, in its pure ſtate, may ſuffice to extend or ſwell the parts of a plant, but affords vegetable matter in a moderate proportion.

However this be, it is agreed on all ſides, that water, ſuch as we find it, is far from being a pure ſimple ſubſtance. The moſt genuine, we know, is mixed with exhalations and diſſolutions of various kinds; and no expedient that has been hitherto diſcovered, is capable of purifying it entirely. If we filter and diſtil it a thouſand times, according to Boerhaave, it will ſtill depoſe a ſediment: and by repeating the proceſs, we may evaporate it entirely away, but can never totally remove its impurities. Some, however, aſſert, that water, properly diſtilled will have no ſediment; and that the little white ſpeck which is found at the bottom of the ſtill, is a ſubſtance that enters from without. Kircher uſed to ſhew, in his Muſæum, a phial of water, that had been kept for fifty years, hermetically ſealed; during which time it depoſed no ſediment, but continued as tranſparent as when firſt it was put in. How far, therefore, it may be brought to a ſtate of purity by diſtillation, is unknown; but we very well know, that all ſuch water as we every where ſee, is a bed in which plants, minerals, and animals, are all found confuſedly floating together.

Rain-water, which is a fluid of Nature's own diſtilling, and which has been raiſed ſo high by evaporation, is, nevertheleſs, a very mixed and impure ſubſtance. Exhalations of all kinds, whether ſalts, ſulphurs, or metals, make a part of its ſubſtance, and tend to increaſe is weight. If we gather the water that falls, after a thunder clap, in a ſulty ſummer's day, and let it ſettle, we ſhall find a real ſalt ſticking at the bottom. In winter, however, its impure mixtures are fewer, but ſtill may be ſeparated by diſtillation. As to that which is generally caught pouring from the tops of houſes, it is particularly foul, being impregnated with the ſmoke of the chimnies, the vapour of the ſlates or tiles, and with other impurities that birds and animals may have depoſited there. Beſides, though it ſhould be ſuppoſed free from all theſe, it is mixed with a quantity of air, which, after being kept for ſome time, will be ſeen to ſeparate.

Spring-water is next in point of purity. This, according to Dr. Halley, is collected from the air itſelf; which being ſated with water, and coming to be condenſed by the evening's cold, is driven againſt the tops of the mountains, where being condenſed, and collected, it trickles down by the ſides, into the cavities of the earth; and running for a while under-ground, bubbles up in fountains upon the plain. This having made but a ſhort circulation, has generally had no long time to diſſolve, or imbibe any foreign ſubſtances by the way.

River-water is generally more foul than the former. Wherever the ſtream flows, it receives a tincture from its channel. Plants, minerals, and animals,

mals, all contribute to add to its impurities: ſo that ſuch as live at the mouths of great rivers, are generally ſubject to all thoſe diſorders which contaminated and unwholeſome waters are known to produce. Of all the river-water in the world, that of the Indus and the Thames, are ſaid to be moſt light and wholeſome.

The moſt impure freſh water that we know, is that of ſtagnating pools and lakes, which, in ſummer, may be more properly conſidered as a jelly of floating inſects, than a collection of water. In this, millions of little reptiles, undiſturbed by any current, which might cruſh their frames to pieces, breed and engender. The whole teems with ſhapeleſs life, and only grows more fruitful by increaſing putrefaction.

Of the purity of all theſe waters, the lightneſs, and not the tranſparency, ought to be the teſt. Water may be extremely clear and beautiful to the eye, and yet very much impregnated with mineral particles. In fact, ſea-water is the moſt tranſparent of any, and yet is well known to contain a large mixture of ſalt and bitumen. On the contrary, thoſe waters which are lighteſt, have the feweſt diſſolutions floating in them; and may, therefore, be the moſt uſeful for all the purpoſes of life. But, after all, though much has been ſaid upon this ſubject; and although waters have been weighed with great aſſiduity, to determine their degree of ſalubrity; yet neither this, nor their curdling with ſoap, nor any other philoſophical ſtandard whatſoever, will anſwer the purpoſes of true information. Experience alone ought to determine the uſeful, or noxious qualities, of every ſpring; and experience aſſures us, that different kinds of water are adapted to different conſtitutions. An inconteſtible proof of this, are the many medicinal ſprings throughout the world, whoſe peculiar benefits are known to the natives of their reſpective countries. Theſe are of various kinds, according to the different minerals with which they are impregnated; hot, ſaline, ſulphureous, bituminous, and oily. But the account of theſe have been already given under that of the ſeveral minerals by which they are produced.

After all therefore, we muſt be contented with an impure mixture for our daily beverage: and yet, perhaps, this very mixture may often be more ſerviceable to our health than that of a purer kind. We know that it is ſo with regard to vegetables: and why not, alſo, in general, to man? Be this as it will, if we are deſirous of having water in its greateſt purity, we are ordered, by the curious in this particular, to diſtil it from ſnow, gathered upon the tops of the higheſt mountains, and to take none but the outer and ſuperficial part thereof. This we muſt be ſatisfied to call pure water; but even this is far ſhort of the pure unmixed philoſophical element; which, in reality, is no where to be found.

As water is thus mixed with foreign matter, and often the repoſitory of minute animals, or vegetable ſeeds, we need not be ſurpriſed that, when carrid to ſea, it is always found to putrefy. But we muſt not ſuppoſe that it is the element itſelf, which thus grows putrid, and offenſive, but the ſubſtances with which it is impregnated. It is true, the utmoſt precautions are taken to deſtroy all vegetable and animal ſubſtances that may have previouſly been lodged in it, by boiling: but, notwithſtanding this, there are ſome that will ſtill ſurvive the operation; and others, that find their way during the time of its ſtowage. Seamen, therefore, aſſure us, that their water is generally found to putrefy twice, at leaſt, and ſometimes three times, in a long voyage. In about a month after it has been at ſea, when the bung is taken out of the caſk, it ſends up a noiſome and dangerous vapour, which would take fire upon the application of a candle. The whole body of the water then is found replete with little worm-like inſects, that float, with great briſkneſs, through all its parts. Theſe generally live for about a couple of days, and then dying, by depoſiting their ſpoils, for a while increaſe the putrefaction. After a time, the heavier parts of theſe ſinking to the bottom, the lighter float, in a ſcum, at the top; and this is what the mariners call, the water's purging itſelf. There are ſtill, however, another race of inſects, which are bred, very probably, from the ſpoils of the former; and produce, after ſome time, ſimilar appearances: theſe dying, the water is then thought to change no more. However, it very often happens, eſpecially in hot climates, that nothing can drive theſe nauſeous inſects from the ſhip's ſtore of water. They often increaſe to a very diſagreeable and frightful ſize, ſo as to deter the mariner, though parching with thirſt, from taſting that cup which they have contaminated.

This water, as thus deſcribed, therefore, is a very different fluid from that ſimple elementary ſubſtance upon which philoſophical theories have been founded; and concerning the nature of which there have been ſo many diſputes. Elementary water is no way compounded; but is without taſte, ſmell, or colour; and incapable of being diſcerned by any of the ſenſes, except the touch. This is the famous diſſolvent of the chemiſts, into which, as they have boaſted, they can reduce all bodies; and which makes up all other ſubſtances, only by putting on a different diſguiſe. In ſome forms, it is fluid, tranſparent, and evaſive of the touch; in others, hard, firm, and elaſtic. In ſome, it is ſtiffened by cold; in others, diſſolved by fire. According to them, it only aſſumes external ſhapes from accidental cauſes; but the mountain is as much a body of water as the cake of ice that melts on its brow; and even the philoſopher himſelf is compoſed of the ſame materials with the cloud or meteor which he contemplates.

Speculation ſeldom reſts when it begins. Others, diſallowing the univerſality of this ſubſtance, will not allow that in a ſtate of nature there is any ſuch thing as water at all. What aſſumes the appearance, ſay they, is nothing more than melted ice. Ice is the real element of Nature's making; and when found in a ſtate of fluidity, it is then in a ſtate of violence. All ſubſtances are naturally hard; but ſome more readily melt with heat than others. It requires a great heat to melt iron; a ſmaller heat will melt copper: ſilver, gold, tin, and lead, melt with ſmaller ſtill; ice, which is a body like the reſt, melts with a very moderate warmth; and quickſilver melts with the ſmalleſt warmth of all. Water, therefore, is but ice kept in continual fuſion; and ſtill returning to its former ſtate, when the heat is taken away. Between theſe oppoſite opinions, the controverſy has been carried on with great ardour; much has been written on both ſides; and yet, when we come to examine the debate, it will probably terminate in this queſtion, whether cold or heat firſt began their operations upon water? This is a fact of very little importance, if known; and what is more, it is a fact we can never know.

Indeed, if we examine into the operations of cold and heat on water, we ſhall find that they produce ſomewhat ſimilar effects. Water dilates in its bulk, by heat, to a very conſiderable degree; and, what is more extraordinary, it is likewiſe dilated by cold in the ſame manner.

If water be placed over a fire, it grows gradually larger in bulk, as it becomes hot, until it begins to boil; after which, no art can either increaſe its bulk, or its heat. By increaſing the fire, indeed, it may be more quickly evaporated away; but its heat

and its bulk, ſtill continue the ſame. By the expanding of this fluid by heat, philoſophers have found a way to determine the warmth or the coldneſs of other bodies: for if put into a glaſs tube, by its ſwelling and riſing, it ſhews the quantity of heat in the body to which it is applied; and by its contracting, and ſinking, it ſhews the abſence of the ſame. Inſtead of uſing water in this inſtrument, which is called a thermometer, they now make uſe of ſpirit of wine, which is not apt to freeze, and which is endued even with a greater expanſion, by heat, than water. The inſtrument conſiſts of nothing more than a hollow ball of glaſs, with a long tube growing out of it. This being partly filled with ſpirits of wine, tinctured red, ſo as to be ſeen when it riſes, the ball is plunged into boiling water, which making the ſpirit within expand and riſe in the tube, the water marks the greateſt height to which it aſcends; at this point the tube is to be broken off, and then hermetically ſealed, by melting the glaſs with a blow-pipe: a ſcale being placed by the ſide, completes the thermometer. Now as the fluid expands or condenſes with heat or cold, it will riſe and fall in the tube in proportion; and the degree or quantity of aſcent or deſcent will be ſeen in the ſcale.

No fire, as was ſaid, can make water hotter, after it begins to boil. We can, therefore, at any time be ſure of an equable certain heat; which is that of boiling water, which is invariably the ſame. The certainty of ſuch an heat is not leſs uſeful than the inſtrument that meaſures it. It affords a ſtandard, fixed, degree of heat over the whole world; boiling water being as hot in Greenland, as upon the coaſts of Guinea. One fire is more intenſe than another: of heat there are various degrees; but boiling water is an heat every where the ſame, and eaſily procurable.

As heat thus expands water; ſo cold, when it is violent enough to freeze the ſame, produces exactly the ſame effect, and expands it likewiſe. Thus water is acted upon in the ſame manner by two oppoſite qualities; being dilated by both. As a proof that it is dilated by cold, we have only to obſerve the ice floating on the ſurface of a pond, which it would not do were it not dilated, and grown more bulky, by freezing, than the water, which remains unfroze. Mr. Boyle, however, put the matter paſt a doubt, by a variety of experiments. Having poured a proper quantity of water into a ſtrong earthen veſſel, he expoſed it, uncovered, to the open air, in froſty nights; and obſerved, that continually the ice reached higher than the water, before it was frozen. He filled alſo a tube with water, and ſtopped both ends with wax: the water, when froze, was found to puſh out the ſtopples from both ends; and a rod of ice appeared at each end of the tube, which ſhewed how much it was ſwollen by the cold within.

From hence, therefore, we may be very certain of the cold's dilating of the water; and experience alſo ſhews, that the force of this expanſion has been found as great as any which heat has been found to produce. The touch-hole of a ſtrong gun barrel being ſtopped, and a plug of iron forcibly driven into the muzzle, after the barrel had been filled with water, it was placed in a mixture of ice and ſalt: the plug, though ſoldered to the barrel, at firſt gave way, but being fixed in more firmly, within a quarter of an hour the gun-barrel burſt with a loud noiſe, and blew up the cover of the box wherein it lay. Such is its force in an ordinary experiment. But it has been known to burſt cannons, filled with water, and then left to freeze; for the cold congealing the water, and the ice ſwelling, it became irreſiſtible. The burſting of rocks, by froſt, which is frequent in the Northern climates, and is ſometimes ſeen in our own, is an equal proof of the expanſion of congealed water; for having, by ſome means, inſinuated itſelf into the body of the rock, it has remained there till the cold was ſufficient to affect it by congelation. But when once frozen, no obſtacle is able to confine it from dilating; and, if it cannot otherwiſe find room, the rock muſt burſt aſunder.

This alteration in the bulk of water, might have ſerved as a proof that it was capable of being compreſſed into a narrower ſpace than it occupied before; but, till of late, water was held to be incompreſſible. The general opinion was, that no art whatſoever could ſqueeze it into a narrower compaſs; that no power on earth, for inſtance, could force a pint of water into a veſſel that held an hair's breadth leſs than a pint. And this, ſaid they, appears from the famous Florentine experiment; where the water, rather than ſuffer compreſſure, was ſeen to ooze through the pores of the ſolid metal; and, at length, making a cleft in the ſide, ſpun out with great vehemence. But later trials have proved that water is very compreſſible, and partakes of that elaſticity which every other body poſſeſſes in ſome degree. Indeed, had not mankind been dazzled by the brilliancy of one inconcluſive experiment, there were numerous reaſons to convince them of its having the ſame properties with other ſubſtances. Ice, which is water in another ſtate, is very elaſtic. A ſtone flung ſlantingly along the ſurface of a pond, bounds from the water ſeveral times; which ſhews it to be elaſtic alſo. But the trials of Mr. Canton have put this paſt all doubt; which being ſomewhat ſimilar to thoſe of the great Boyle, who preſſed it with weights properly applied, carry ſufficient conviction.

What has been hitherto related, is chiefly applicable to the element of water alone; but its fluidity is a property that it poſſeſſes in common with ſeveral other ſubſtances, in other reſpects greatly differing from it. That quality which gives riſe to the definition of a fluid, namely, that its parts are in a continual inteſtine motion, ſeems extremely applicable to water. What the ſhapes of thoſe parts are, it would be vain to attempt to diſcover. Every trial only ſhews the futility of the attempt; all we find is, that they are extremely minute; and that they roll over each other with the greateſt eaſe. Some, indeed, from this property alone, have not heſitated to pronounce them globular; and we have, in all our hydroſtatical books, pictures of theſe little globes in a ſtate of ſliding and rolling over each other. But all this is merely the work of imagination; we know that ſubſtances of any kind, reduced very ſmall, aſſume a fluid appearance, ſomewhat reſembling that of water. Mr. Boyle, after finely powdering and ſifting a little dry powder of plaiſter of Paris, put it in a veſſel over the fire, where it ſoon began to boil like water, exhibiting all the motions and appearances of a boiling liquor. Although but a powder, the parts of which we know are very different from each other, and juſt as accident has formed them, yet it heaved in great waves, like water. Upon agitation, an heavy body will ſink to the bottom, and a light one emerge to the top. There is no reaſon to ſuppoſe the figure of the parts of water round, ſince we ſee their fluidity very well imitated by a compoſition, the parts of which are of various forms and ſizes. The ſhape of the parts of water, therefore, we muſt be content to continue ignorant of. All we know is, that earth, air, and fire, conduce to ſeparate the parts from each other.

Earthy ſubſtances divide the parts from each other, and keep them aſunder. This diviſion may be ſo great, that the water will entirely loſe its fluidity thereby. Mud, potter's clay, and dried bricks, are ſo many different combinations of earth and water; each ſubſtance in which the parts of water are moſt ſeparated from each other, appearing to be

the moſt dry. In ſome ſubſtances, indeed, where the parts of water are greatly divided, as in porcelane, for inſtance, it is no eaſy matter to recover and bring them together again; but they continue in a manner fixed and united to the manufactured clay. This circumſtance led Doctor Cheney into a very peculiar ſtrain of thinking. He ſuſpected that the quantity of water, on the ſurface of the earth, was daily decreaſing. For, ſays he, ſome parts of it are continually joined to vegetable, animal, and mineral ſubſtances, which no art can again recover. United with theſe, the water loſes its fluidity; for if, continues he, we ſeparate a few particles of any fluid, and faſten them to a ſolid body, or keep them aſunder, they will be fluid no longer. To produce fluidity, a conſiderable number of ſuch particles are required; but here they are cloſe, and deſtitute of their natural properties. Thus, according to him, the world is growing every day harder and harder, and the earth firmer and firmer; and there may come a time when every object around us may be ſtiffened in univerſal frigidity! However, we have cauſes enough of anxiety in this world already, not to add this prepoſterous concern to the number.

That air alſo contributes to divide the parts of water, we can have no manner of doubt; ſome have even diſputed whether water be not capable of being turned into air. Though this cannot be allowed, it muſt be granted, that it may be turned into a ſubſtance which greatly reſembles air (as we have ſeen in the experiment of the æolipile) with all its properties; except that, by cold, this new-made air may be condenſed again into water.

But of all the ſubſtances which tend to divide the parts of water, fire is the moſt powerful. Water, when heated into ſteam, acquires ſuch force, and the parts of it tend to fly off from each other with ſuch violence, that no earthly ſubſtance we know of, is ſtrong enough to confine them. A ſingle drop of water, converted into ſteam, has been found capable of raiſing a weight of twenty tons; and would have raiſed twenty thouſand, were the veſſel confining it ſufficiently ſtrong, and the fire below increaſed in proportion.

From this eaſy yielding of its parts to external preſſure, ariſes the art of determining the ſpecific gravity of bodies by plunging them in water; with many other uſeful diſcoveries in that part of natural philoſophy, called hydroſtatics. The laws of this ſcience, which Archimedes began, and Paſcal, with ſome other of the moderns, have improved, rather belongs to experimental than to natural hiſtory. However, we ſhall mention ſome of the moſt ſtriking paradoxes in this branch of ſcience, which are as well confirmed by experiment, as rendered univerſal by theory. It would, indeed, be unpardonable, while diſcourſing on the properties of water, to omit giving ſome account of the manner in which it ſuſtains ſuch immenſe bulks as we ſee floating upon its ſoft and yielding ſurface: how ſome bodies, that are known to ſink at one time, ſwim with eaſe, if their ſurface be enlarged: how the heavieſt body, even gold itſelf, may be made to ſwim upon water; and how the lighteſt, ſuch as cork, ſhall remain ſunk at the bottom: how the pouring in of a ſingle quart of water, will burſt an hogſhead hooped with iron: and how it aſcends, in pipes, from the valley, to travel over the mountain: theſe are circumſtances that are at firſt ſurpriſing; but, upon a ſlight conſideration, loſe their wonder.

In order to conceive the manner in which all theſe wonders are effected, we muſt begin by obſerving that water is poſſeſſed of an invariable property, which has not hitherto been mentioned; that of always keeping its ſurface level and even. Winds, indeed, may raiſe it into waves; or art ſpurt it up in fountains; but ever, when left to itſelf, it ſinks into a ſmooth even ſurface, of which no one part is higher than another. If any one ſhould pour water, for inſtance, into the arm of a pipe of the ſhape of the letter U, the fluid would riſe in the other arm juſt to the ſame height; becauſe, otherwiſe, it would not find its level, which it invariably maintains. A pipe bending from one hill down into the valley, and riſing by another, my be conſidered as a tube of this kind, in which the water, ſinking in one arm, riſes to maintain its level in the other. Upon this principle all water-pipes depend; which can never raiſe the water higher than the fountain from which they proceed.

Again, let us ſuppoſe for a moment, that the arms of the pipe already mentioned, may be made long or ſhort at pleaſure; and let us ſtill further ſuppoſe, that there is ſome obſtacle at the bottom of it, which prevents the water poured into one arm, from riſing in the other. Now it is evident, that this obſtacle at the bottom will ſuſtain a preſſure from the water in one arm, equal to what would make it riſe in the other; and this preſſure will be great, in proportion as the arm filled with water is tall. We may, therefore, generally conclude, that the bottom of every veſſel is preſſed by a force, in proportion to the height of the water in that veſſel. For inſtance, if the veſſel filled with water be forty feet high, the bottom of that veſſel will ſuſtain ſuch a preſſure as would raiſe the ſame water forty feet high, which is very great. From hence we ſee how extremely apt our pipes that convey water to the city are to burſt; for deſcending from an hill of more than forty feet high, they are preſſed by the water contained in them, with a force equal to what would raiſe it more than forty feet high; and that this is ſometimes able to burſt a wooden pipe, we can have no room to doubt of.

Still recurring to our pipe, let us ſuppoſe one of its arms ten times as thick as the other; this will produce no effect whatſoever upon the obſtacle below, which we ſuppoſed hindering its riſe in the other arm; becauſe, how thick ſoever the pipe may be, its contents would only riſe to its own level; and it will, therefore, preſs the obſtacle with an equal force. We may, therefore, univerſally conclude, that the bottom of any veſſel is preſſed by its water, not as it is broad or narrow, but in proportion as it is high. Thus the water contained in a veſſel not thicker than one's finger, preſſes its bottom as forcibly as the water contained in an hogſhead of an equal height; and, if we made holes in the bottoms of both, the water would burſt out as forceful from the one as the other. Hence me may, with great eaſe, burſt an hogſhead with a ſingle quart of water, and it has been often done. We have only, for this, to place an hogſhead on one end, filled with water: we then bore an hole in its top, into which we plant a narrow tin pipe, of about thirty feet high: by pouring a quart of water into this, at the top, as it continues to riſe higher in the pipe, it will preſs more forcibly on the bottom and ſides of the hogſhead below, and at laſt burſt it.

Still returning to our ſimple inſtrument of demonſtration. If we ſuppoſe the obſtacle at the bottom of the pipe to be moveable, ſo as that the force of the water can puſh it up into the other arm; ſuch a body is quickſilver, for inſtance. Now, it is evident, that the weight of water weighing down upon this quickſilver in one arm, will at laſt preſs it up in the other arm; and will continue to preſs it upwards, until the fluid in both arms be upon a par. So that here we actually ſee quickſilver, the heavieſt ſubſtance in the world except gold, floating upon water, which is but a very light ſubſtance.

When we ſee water thus capable of ſuſtaining quickſilver, we need not be ſurpriſed that it is capable of floating much lighter ſubſtances, ſhips, animals,

animals, or timber. When any thing floats upon water, we always ſee that a part of it ſinks in the ſame. A cork, a ſhip, a buoy, each buries itſelf a bed on the ſurface of the water; this bed may be conſidered as ſo much water diſplaced; the water will, therefore, loſe ſo much of its own weight as is equal to the weight of that bed of water which it diſplaces. If the body be heavier than a ſimilar bulk of water, it will ſink; if lighter, it will ſwim. Univerſally, therefore, a body plunged in water, loſes as much of its weight as is equal to the weight of a body of water of its own bulk. Some light bodies, therefore, ſuch as cork, loſe much of their weight, and therefore ſwim; other more ponderous bodies ſink, becauſe they are heavier than their bulk of water.

Upon this ſimple theorem entirely depends the art of weighing metals hydroſtatically. A perſon has a guinea, for inſtance, and deſires to know whether it be pure gold: it has been weighed in the uſual way with another guinea, and been found exactly of the ſame weight, but ſtill there is ſome ſuſpicion, from its greater bulk, that it is not pure. In order to determine this, there is nothing more to be done than to weigh it in water with that ſame guinea that is known to be good, and of the ſame weight; and this will inſtantly ſhew the difference; for the true ponderous metal will ſink, and the falſe bulky one will be ſuſtained in proportion to the greatneſs of its ſurface. Thoſe whoſe buſineſs it is to examine the purity of metals, have a balance made for this purpoſe, by which they can preciſely determine which is moſt ponderous, or, as it is expreſſed, which has the greateſt ſpecific gravity. Seventy-one pound and an half of quickſilver is found to be equal in bulk to an hundred pound weight of gold. In the ſame proportion, ſixty of lead, fifty-four of ſilver, forty-ſeven of copper, forty-five of braſs, forty-two of iron, and thirty-nine of tin, are each equal to an hundred pound of the moſt ponderous of all metals.

This method of preciſely determining the purity of gold, by weighing in water, was firſt diſcovered by Archimedes, to whom mankind have been indebted for many uſeful diſcoveries. Hiero, king of Sicily, having ſent a certain quantity of gold to be made into a crown, the workman, it ſeems, kept a part for his own uſe, and ſupplied the deficiency with a baſer metal. His fraud was ſuſpected by the king, but could not be detected, till he applied to Archimedes, who weighed the crown in water; and, by this method, informed the king of the quantity of gold which was taken away.

It has been ſaid, that all fluids endeavour to preſerve their level; and, likewiſe, that a body preſſing on the ſurface, tended to deſtroy that level. From hence it will eaſily be inferred, that the deeper any body ſinks, the greater will be the reſiſtance of the depreſſed fluid beneath. It will be aſked, therefore, as the reſiſtance increaſes in proportion as the body deſcends, how comes the body, after it is got a certain way, to ſink at all? The anſwer is obvious. From the fluid above preſſing it down with almoſt as great a force as the fluid beneath preſſes it up. Take away, by any art, the preſſure of the fluid from above, and let only the reſiſtance of the fluid from below be ſuffered to act, and after the body is got down very deep, the reſiſtance will be inſuperable. To give an inſtance: a ſmall hole opens in the bottom of a ſhip at ſea, forty feet we will ſuppoſe below the ſurface of the water; through this the water burſts up with great violence; a perſon attempts to ſtop it with his hand, but it puſhes the hand violently away. Here the hand is, in fact, a body attempting to ſink upon water, at a depth of forty feet, with the preſſure from above taken away. The water, therefore, will overcome his ſtrength; and will continue to burſt in till it has got to its level: if he ſhould then dive into the hold, and clap his hand upon the opening, as before, he ſhall perceive no force acting againſt his hand at all, for the water above preſſes the hand as much down againſt the hole, as the water without preſſes it upward. For this reaſon alſo, when we dive to the bottom of the water, we ſuſtain a very great preſſure from above, it is true, but it is counteracted by the preſſure from below; and the whole acting uniformly on the ſurface of the body, wraps us cloſe round without injury.

As we have deviated thus far, we will juſt mention one or two properties more, which water, and all ſuch like fluids, is found to poſſeſs. And firſt, their aſcending in veſſels which are emptied of air, as in our common pumps for inſtance. The air, however, being the agent in this caſe, we muſt previouſly examine its properties, before we undertake the explanation. The other property to be mentioned is, that of their aſcending in ſmall capillary tubes. This is one of the moſt extraordinary and inſcrutable appearances in nature. Glaſs tubes may be drawn, by means of a lamp, as fine as an hair; ſtill preſerving their hollow within. If one of theſe be planted in a veſſel of water, or ſpirit of wine, the liquor will immediately be ſeen to aſcend; and it will riſe higher, in proportion as the tube is ſmaller; a foot, two feet, and more. How does this come to paſs? Is the air the cauſe? No: the liquor riſes, although the air be taken away. Is attraction the caſe? No: for quickſilver does not aſcend, which it otherwiſe would. Many have been the theories of experimental philoſophers to explain this property. Such as are fond of travelling in the regions of conjecture, may conſult Hawkſbee, Morgan, Jurin, or Watſon, who have examined the ſubject with great minuteneſs. Hitherto, however, nothing but doubts inſtead of knowledge have been the reſult of their enquiries. It will not, therefore, become us to enter into the minuteneſs of the enquiry, when we have ſo many greater wonders to call our attention away.

CHAP. XIV.

Of the Origin of RIVERS.

"THE ſun ariſeth, and the ſun goeth down, and pants for the place from whence he aroſe. All things are filled with labour, and man cannot utter it. All rivers run into the ſea, yet the ſea is not full. Unto the place whence the rivers come, thither they return again. The eye is not ſatisfied with ſeeing, nor the ear with hearing." Thus ſpeaks the wiſeſt of the Jews. And, at ſo early a period was the curioſity of man employed in obſerving theſe great circulations of nature. Every eye attempted to explain thoſe appearances; and every philoſopher who has long thought upon the ſubject, ſeems to give a peculiar ſolution. The enquiry whence rivers are produced; whence they derive thoſe unceaſing ſtores of water, which continually enrich the world with fertility and verdure; has been variouſly conſidered; and divided the opinions of mankind, more than any other topic in natural hiſtory.

In this conteſt, the various champions may be claſſed under two leaders, Mr. De La Hire, who contends that rivers muſt be ſupplied from the ſea, ſtrained through the pores of the earth; and Doctor Halley, who has endeavoured to demonſtrate, that the clouds alone are ſufficient for the ſupply. Both ſides have brought in mathematics to their aid; and have ſhewn, that long and laborious calculations can at any time be made, to obſcure both ſides of a queſtion.

De La Hire begins his proofs, that rain-water,

evaporated

evaporated from the ſea, is inſufficient for the production of rivers; by ſhewing, that rain never penetrates the ſurface of the earth above ſixteen inches. From thence he infers, that it is impoſſible for it, in many caſes, to ſink ſo as to be found at ſuch conſiderable depths below. Rain-water, he grants, is often ſeen to mix with rivers, and to ſwell their currents; but a much greater part of it evaporates. In fact, continues he, if we ſuppoſe the earth every where covered with water, evaporation alone would be ſufficient to carry off two feet nine inches of it in a year: and yet, we very well know, that ſcarce nineteen inches of rain-water falls in that time; ſo that evaporation would carry off a much greater quantity than is ever known to deſcend. The ſmall quantity of rain-water that falls is therefore but barely ſufficient for the purpoſes of vegetation. Two leaves of a fig-tree have been found, by experiment, to imbibe from the earth, in five hours and an half, two ounces of water. This implies the great quantity of fluid that muſt be exhauſted in the maintenance of one ſingle plant. Add to this, that the waters of the river Rungis will, by calculation, riſe to fifty inches; and the whole country from whence they are ſupplied, never receives fifty inches, in the year, by rain. Beſides this, there are many ſalt ſprings, which are known to proceed immediately from the ſea, and are ſubject to its flux and reflux. In ſhort, wherever we dig beneath the ſurface of the earth, except in a very few inſtances, water is to be found; and it is by this ſubterraneous water, that ſprings and rivers, nay, a great part of vegetation itſelf, is ſupported. It is this ſubterraneous water, which is raiſed into ſteam, by the internal heat of the earth, that feeds plants. It is this ſubterraneous water that diſtils through its interſtices; and there cooling, forms fountains. It is this that, by the addition of rains, is increaſed into rivers; and pours plenty over the whole earth.

On the other ſide of the queſtion, it is aſſerted, that the vapours which are exhaled from the ſea, and driven by the winds upon land, are more than ſufficient to ſupply not only plants with moiſture, but alſo to furniſh a ſufficiency of water to the greateſt rivers. For this purpoſe, an eſtimate has been made of the quantity of water emptied at the mouth of the greateſt rivers; and of the quantity alſo raiſed from the ſea by evaporation; and it has been found, that the latter by far exceeds the former. This calculation was made by Mr. Mariotte. By him it was found, upon receiving ſuch rain as fell in a year, in a proper veſſel, fitted for that purpoſe, that, one year with another, there might fall about twenty inches of water upon the ſurface of the earth, throughout Europe. It was alſo computed, that the river Seine, from its ſource to the city of Paris, might cover an extent of ground, that would ſupply it annually with above ſeven millions of cubic feet of this water, formed by evaporation. But, upon computing the quantity which paſſed through the arches of one of its bridges in a year, it was found to amount only to two hundred and eighty millions of cubic feet, which is not above the ſixth part of the former number. Hence it appears, that this river may receive a ſupply brought to it by the evaporated waters of the ſea, ſix times greater than what it gives back to the ſea by its current; and, therefore, evaporation is more than ſufficient for maintaining the greateſt rivers; and ſupplying the purpoſes alſo of vegetation.

In this manner the ſea furniſhes ſufficient humidity to the air for furniſhing the earth with all neceſſary moiſture. One part of its vapours fall upon its own boſom, before they arrive upon land. Another part is arreſted by the ſides of mountains, and is compelled, by the riſing ſtream of air, to mount upward towards the ſummits. Here it is preſently precipitated, dripping down by the crannies of the ſtone. In ſome places, entering into the caverns of the mountain, it gathers in thoſe receptacles, which being once filled, all the reſt overflows; and breaking out by the ſides of the hills, forms ſingle ſprings. Many of theſe run down by the valleys, or guts, between the ridges of the mountain, and form little rivulets or brooks; many of theſe meeting in one common valley, and gaining the plain ground, being grown leſs rapid, become a river: and many of theſe uniting, make ſuch vaſt bodies of water as the Rhine, the Rhone, and the Danube.

There is ſtill a third part, which falls upon the lower grounds, and furniſhes plants with their wonted ſupply. But the circulation does not reſt even here; for it is again exhaled into vapour by the action of the ſun; and afterwards returned to that great maſs of waters whence it firſt aroſe. This, adds Doctor Halley, ſeems the moſt reaſonable hypotheſis; and much more likely to be true, than that of thoſe who derive all ſprings from the filtering of the ſea waters through certain imaginary tubes or paſſages within the earth; ſince it is well known, that the greateſt rivers have their moſt copious fountains the moſt remote from the ſea.

This ſeems the moſt general opinion; and yet, after all, it is ſtill preſſed with great difficulties; and there is ſtill room to look out for a better theory. The perpetuity of many ſprings, which always yield the ſame quantity when the leaſt rain or vapour is afforded, as well as when the greateſt, is a ſtrong objection. Derham mentions a ſpring at Upminſter, which he could never perceive by his eye to be diminiſhed, in the greateſt droughts, even when all the ponds in the country, as well as an adjoining brook, have been dry for ſeveral months together. In the rainy ſeaſons alſo, it was never overflowed; except ſometimes, perhaps, for an hour or ſo, upon the immiſion of the external rains. He, therefore, juſtly enough concludes, that had this ſpring its origin from rain or vapour, there would be found an increaſe or decreaſe of its water, correſponding to the cauſes of its production.

Thus the reader, after having been toſſed from one hypotheſis to another, muſt at laſt be contented to ſettle in conſcious ignorance. All that has been written upon this ſubject, affords him rather ſomething to ſay, than ſomething to think; ſomething rather for others than for himſelf. Varenius, indeed, although he is at a loſs for the origin of rivers, is by no means ſo as to their formation. He is pretty poſitive that all rivers are artificial. He boldly aſſerts, that their channels have been originally formed by the induſtry of man. His reaſons are, that when a new ſpring breaks forth, the water does not make itſelf a new channel, but ſpreads over the adjacent land. Thus, ſays he, men are obliged to direct its courſe; or, otherwiſe, Nature would never have found one. He enumerates many rivers, that are certainly known, from hiſtory, to have been dug by men. He alledges, that no ſalt-water rivers are found, becauſe men did not want ſalt-water; and as for ſalt, that was procurable at a leſs expence than digging a river for it. However, it coſts a ſpeculative man but a ſmall expence of thinking to form ſuch an hypotheſis. It may, perhaps, engroſs the reader's patience to detain him longer upon it.

Nevertheleſs, though philoſophy be thus ignorant, as to the production of rivers, yet the laws of their motion, and the nature of their currents, have been very well explained. The Italians have particularly diſtinguiſhed themſelves in this reſpect; and it is chiefly to them that we are indebted for the improvement.

All rivers have their ſource, either in mountains, or elevated lakes; and it is in their deſcent from theſe,

these, that they acquire that velocity which maintains their future current. At first their course is generally rapid and headlong; but it is retarded in its journey by the continual friction against its banks, by the many obstacles it meets to divert its stream, and by the plains generally becoming more level as it approaches towards the sea.

If this acquired velocity be quite spent, and the plain through which the river passes is entirely level, it will, notwithstanding, still continue to run from the perpendicular pressure of the water, which is always in exact proportion to the depth. This perpendicular pressure is nothing more than the weight of the upper waters pressing the lower out of their places, and, consequently, driving them forward, as they cannot recede against the stream. As this pressure is greatest in the deepest parts of the river, so we generally find the middle of the stream most rapid; both because it has the greatest motion thus communicated by the pressure, and the fewest obstructions from the banks on either side.

Rivers thus set into motion are almost always found to make their own beds. When they find the bed elevated, they wear its substance away, and deposit the sediment in the next hollow, so as in time to make the bottom of their channels even. On the other hand, the water is continually gnawing and eating away the banks on each side; and this with more force as the current happens to strike more directly against them. By these means, it always has a tendency to render them more strait and parallel to its own course. Thus it continues to rectify its banks, and enlarge its bed; and, consequently, to diminish the force of its stream, till there becomes an equilibrium between the force of the water, and the resistance of its banks, upon which both will remain without any further mutation. And it is happy for man that bounds are thus put to the erosion of the earth by water; and that we find all rivers only dig and widen themselves but to a certain degree.

In those plains and large valleys where great rivers flow, the bed of the river is usually lower than any part of the valley: but it often happens, that the surface of the water is higher than many of the grounds that are adjacent to the banks of the stream. If, after inundations, we take a view of some rivers, we shall find their banks appear above water, at a time that all the adjacent valley is overflown. This proceeds from the frequent deposition of mud, and such like substances, upon the banks, by the rivers frequently overflowing; and thus, by degrees, they become elevated above the plain; and the water is often seen higher also.

Rivers, as every body has seen, are always broadest at the mouth; and grow narrower towards their source. But what is less known, and probably more deserving curiosity, is, that they run in a more direct channel as they immediately leave their sources; and that their sinuosities and turnings become more numerous as they proceed. It is a certain sign among the savages of North America, that they are near the sea, when they find the rivers winding, and every now and then changing their direction. And this is even now become an indication to the Europeans themselves, in their journies through those trackless forests. As those sinuosities, therefore, increase as the river approaches the sea, it is not to be wondered at, that they sometimes divide, and thus disembogue by different channels. The Danube disembogues into the Euxine by seven mouths; the Nile, by the same number; and the Wolga, by seventy.

The currents of rivers, are to be estimated very differently from the manner in which those writers, who have given us mathematical theories on this subject, represent them. They found their calculations upon the surface being a perfect plain, from one bank to the other; but this is not the actual state of nature; for rivers, in general, rise in the middle; and this convexity is greatest in proportion as the rapidity is greater. Any person, to be convinced of this, need only lay his eye as nearly as he can on a level with the stream, and looking across to the opposite bank, he will perceive the river in the midst to be elevated considerably above what it is at the edges. This rising, in some rivers, is often found to be three feet high; and is ever increased, in proportion to the rapidity of the stream. In this case, the water in the midst of the current loses a part of its weight, from the velocity of its motion; while that at the sides, for the contrary reason, sinks lower. It sometimes, however, happens, that this appearance is reversed; for when tides are found to flow up with violence against the natural current of the water, the greatest rapidity is then found at the sides of the river, as the water there resists the influx from the sea. On those occasions, therefore, the river presents a concave rather than a convex surface; and, as in the former case, the middle waters rose in a ridge; in this case, they sink in a furrow.

The stream of all rivers is more rapid in proportion as its channel is diminished. For instance, it will be much swifter where it is ten yards broad, than where it is twenty; for the force behind still pushing the water forward, when it comes to the narrow part, it must make up by velocity what it wants in room.

It often happens that the stream of a river is opposed by one of its jutting banks, by an island in the midst, the arches of a bridge, or some such obstacle. This produces, not unfrequently, a back current; and the water having past the arch with great velocity, pushes the water on each side of its direct current.

This produces a side current, tending to the banks, and not unfrequently a whirlpool; in which a large body of waters are circulated in a kind of cavity, sinking down in the middle. The central point of the whirlpool is always lowest, because it has the least motion: the other parts are supported, in some measure, by the violence of theirs; and, consequently, rise higher as their motion is greater; so that towards the extremity of the whirlpool must be higher than towards the center.

If the stream of a river be stopped at the surface, and yet be free below; for instance, if it be laid over by a bridge of boats, there will then be a double current; the water at the surface will flow back, while that at the bottom will proceed with increased velocity. It often happens that the current at the bottom is swifter than at the top, when, upon violent land-floods, the weight of waters towards the source presses the waters at the bottom, before it has had time to communicate its motion to the surface. However, in all other cases, the surface of the stream is swifter than the bottom, as it is not retarded by rubbing over the bed of the river.

It might be supposed that bridges, dams, and other obstacles in the current of a river, would retard its velocity: but the difference they make is very inconsiderable. The water, by these stoppages, gets an elevation above the object; which, when it has surmounted, it gives a velocity that recompences the former delay. Islands and turnings also retard the course of the stream but very inconsiderably; any cause which diminishes the quantity of the water, most sensibly diminishes the force and the velocity of the stream.

An increase of water in the bed of the river always increases its rapidity, except in cases of inundation. The instant the river has overflowed its

banks, the velocity of its current is always turned that way, and the inundation is perceived to continue for ſome days; which it would not otherwiſe do, if, as ſoon as the cauſe was diſcontinued, it acquired its former rapidity.

A violent ſtorm, that ſets directly up againſt the courſe of the ſtream, will always retard, and ſometimes entirely ſtop its courſe. We have ſeen an inſtance of this, when the bed of a large river was left entirely dry for ſome hours, and fiſh were caught among the ſtones at the bottom.

Inundations are generally greater towards the ſource of rivers, than farther down; becauſe the current is generally ſwifter below than above; and that for the reaſon already aſſigned.

A little river may be received into a large one, without augmenting either its width or depth. This, which at firſt view ſeems a paradox, is yet very eaſily accounted for. The little river, in this caſe, only goes towards increaſing the ſwiftneſs of the larger, and putting its dormant waters into motion. In this manner, the Venetian branch of the Po was puſhed on by the Ferareſe branch and that of Panaro, without any enlargement of its breadth or depth from theſe acceſſions.

A river tending to enter another, either perpendicularly, or in an oppoſite direction, will be diverted, by degrees, from that direction; and be obliged to make itſelf a more favourable entrance downward, and more conſpiring with the ſtream of the former.

The union of two rivers into one, makes it flow the ſwifter; ſince the ſame quantity of water, inſtead of rubbing againſt four ſhores, now only rubs againſt two. And, beſides, the current being deeper, becomes of conſequence more fitted for motion.

With reſpect to the places from whence rivers proceed, it may be taken for a general rule, that the largeſt and higheſt mountains ſupply the greateſt and moſt extenſive rivers. It may alſo be remarked, in whatever direction the ridge of the mountain runs, the river takes an oppoſite courſe. If the mountain, for inſtance, ſtretches from north to ſouth, the river runs from eaſt to weſt; and ſo contrariwiſe. Theſe are ſome of the moſt generally received opinions with regard to the courſe of rivers; however, they are liable to many exceptions; and nothing but an actual knowledge of each particular river can furniſh us with an exact theory of its current.

The largeſt rivers of Europe are, firſt, the Wolga, which is about ſix hundred and fifty leagues in length, extending from Reſchow to Aſtrachan. It is remarkable of this river, that it abounds with water during the ſummer months of May and June; but all the reſt of the year is ſo ſhallow as ſcarce to cover its bottom, or allow a paſſage for loaded veſſels that trade up its ſtream. It was up this river that the Engliſh attempted to trade into Perſia, in which they were ſo unhappily diſappointed, in the year 1741. The next in order is the Danube. The courſe of this is about four hundred and fifty leagues, from the mountains of Switzerland to the Black Sea. It is ſo deep between Buda and Belgrade, that the Turks and Chriſtians have fleets of men of war upon it, which frequently engaged, during the laſt war between the Ottomans and the Auſtrians: however, it is unnavigable further down, by reaſon of its cataracts, which prevent its commerce into the Black Sea. The Don, or Tanais, which is four hundred leagues from the ſource of that branch of it called the Sofna, to its mouth in the Euxine ſea. In one part of its courſe it approaches near the Wolga; and Peter the Great had actually begun a canal, by which he intended joining thoſe two rivers; but this he did not live to finiſh. The Nieper, or Boriſthenes, which riſes in the middle of Muſcovy, and runs a courſe of three hundred and fifty leagues, to empty itſelf into the Black Sea. The Old Coſſacks inhabit the banks and iſlands of this river; and frequently croſs the Black Sea, to plunder the maritime places on the coaſts of Turkey. The Dwina, which takes its riſe in a province of the ſame name in Ruſſia, that runs a courſe of three hundred leagues, and diſembogues into the White Sea, a little below Archangel.

The largeſt rivers of Aſia are, the Hoanho, in China, which is eight hundred and fifty leagues in length, computing from its ſource at Raja Ribron, to its mouth in the Gulph of Changi. The Jeniſca of Tartary, about eight hundred leagues in length, from the Lake Selinga to the Icy Sea. This river is, by ſome, ſuppoſed to ſupply moſt of that great quantity of drift wood which is ſeen floating in the ſeas, near the Arctic circle. The Oby, of five hundred leagues, running from the lake of Kila into the Northern ſea. The Amour, in Eaſtern Tartary, whoſe courſe is about five hundred and ſeventy-five leagues, from its ſource to its entrance into the ſea of Kamtſchatka. The Kiam, in China, five hundred and fifty leagues in length. The Ganges, one of the moſt noted rivers in the world, and about as long as the former. It riſes in the mountains which ſeparate India from Tartary; and running through the dominions of the Great Mogul, diſcharges itſelf by ſeveral mouths into the bay of Bengal. It is not only eſteemed by the Indians for the depth, and pureneſs of its ſtream, but for a ſuppoſed ſanctity which they believe to be in its waters. It is viſited annually by ſeveral hundred thouſand pilgrims, who pay their devotions to the river as to a god; for ſavage ſimplicity is always known to miſtake the bleſſings of the Deity for the Deity himſelf. They carry their dying friends from diſtant countries, to expire on its banks; and to be buried in its ſtream. The water is loweſt in April or May; but the rains beginning to fall ſoon after, the flat country is overflowed for ſeveral miles, till about the end of September; the waters then begin to retire, leaving a prolific ſediment behind, that enriches the ſoil, and, in a few days time, gives a luxuriance to vegetation, beyond what can be conceived by an European. Next to this may be reckoned the ſtill more celebrated river Euphrates. This riſes from two ſources, northward of the city Erzerum, in Turcomania; and unites about three days journey below the ſame; from whence, after performing a courſe of five hundred leagues, it falls into the Gulph of Perſia, fifty miles below the city of Baſſora in Arabia. The river Indus is extended from its ſource to its diſcharge into the Arabian ſea, four hundred leagues.

The largeſt rivers of Africa are, the Senegal, which runs a courſe of not leſs than eleven hundred leagues, comprehending the Niger, which ſome have ſuppoſed to fall into it. However, later accounts ſeem to affirm that the Niger is loſt in the ſands, about three hundred miles up from the weſtern coaſts of Africa. Be this as it may, the Senegal is well known to be navigable for more than three hundred leagues up the country; and how much higher it may reach is not yet diſcovered, as the dreadful fatality of the inland parts of Africa, not only deter curioſity, but even avarice, which is a much ſtronger paſſion. At the end of laſt war, of fifty Engliſhmen that were ſent to the factory at Galam, a place taken from the French, and nine hundred miles up the river, only one returned to tell the fate of his companions, who were deſtroyed by the climate. The celebrated river Nile is ſaid to be nine hundred and ſeventy leagues, from its ſource among the mountains of the Moon, in Upper Æthiopia, to its opening into the Mediterranean

terranean ſea. The ſources of this river were conſidered as inſcrutable by the ancients; and the cauſes of its periodical inundation were equally known. They have both been aſcertained by the miſſionaries who have travelled into the interior parts of Æthiopia. The Nile takes its riſe in the kingdom of Gojam, from a ſmall aperture on the top of a mountain, which, though not above a foot and an half over, yet was unfathomable. This fountain, when arrived at the foot of the mountain, expands into a river; and being joined by others, forms a lake thirty leagues long, and as many broad; from this, its channel, in ſome meaſure, winds back to the country where it firſt began; from thence, precipitating by frightful cataracts, it travels through a variety of deſart regions, equally formidable, ſuch as Amhara, Olaca, Damot, and Xaoa. Upon its arrival in the kingdom of Upper Egypt, it runs through a rocky channel, which ſome late travellers have miſtaken for its cataracts. In the beginning of its courſe, it receives many leſſer rivers into it; and Pliny was miſtaken, in ſaying that it received none. In the beginning alſo of its courſe, it has many windings; but, for above three hundred leagues from the ſea, runs in a direct line. Its annual overflowings ariſe from a very obvious cauſe, which is almoſt univerſal with the great rivers that take their ſource near the Line. The rainy ſeaſon, which is periodical in thoſe climates, flood the rivers; and as this always happens in our ſummer, ſo the Nile is at that time overflown. From theſe inundations, the inhabitants of Egypt derive happineſs and plenty; and, when the river does not ariſe to its accuſtomed heights, they prepare for an indifferent harveſt. It begins to overflow about the ſeventeenth of June; it generally continues to augment for forty days, and decreaſes in about as many more. The time of increaſe and decreaſe, however, is much more inconſiderable now than it was among the ancients. Herodotus informs us, that it was an hundred days riſing, and as many falling; which ſhews that the inundation was much greater at that time than at preſent. Mr. Buffon has aſcribed the preſent diminution, as well to the leſſening of the mountains of the Moon, by their ſubſtance having ſo long been waſhed down with the ſtream, as to the riſing of the earth in Egypt, that has for ſo many ages received this extraneous ſupply. But we do not find, by the buildings that have remained ſince the times of the ancients, that the earth is much raiſed ſince then. Beſides the Nile in Africa, we may reckon the Zara, and the Coanza, from the greatneſs of whoſe openings into the ſea, and the rapidity of whoſe ſtreams, we form an eſtimate of the great diſtance from whence they come. Their courſes, however, are ſpent in watering deſarts and ſavage countries, whoſe poverty or fierceneſs have kept ſtrangers away.

But of all parts of the world, America, as it exhibits the moſt lofty mountains, ſo alſo it ſupplies the largeſt rivers. The foremoſt of theſe is the great river Amazons, which, from its ſource in the lake of Lauricocha, to its diſcharge into the Weſtern Ocean, performs a courſe of more than twelve hundred leagues. The breadth and depth of this river is anſwerable to its vaſt length; and, where its width is moſt contracted, its depth is augmented in proportion. So great is the body of its waters, that other rivers, though before the objects of admiration, are loſt in its boſom. It proceeds, after their junction, with its uſual appearance, without any viſible change in its breadth or rapidity; and, if we may ſo expreſs it, remains great without oſtentation. In ſome places it diſplays its whole magnificence, dividing into ſeveral large branches, and encompaſſing a multitude of iſlands; and, at length, diſcharging itſelf into the ocean, by a channel of an hundred and fifty miles broad. Another river, that may almoſt rival the former, is the St. Lawrence, in Canada, which riſing in the lake Aſſiniboils, paſſes from one lake to another, from Criſtinaux to Alempigo; from thence to lake Superior; thence to the lake Hurons; to lake Erie; to lake Ontario; and, at laſt, after a courſe of nine hundred leagues, pours their collected waters into the Atlantic ocean. The river Miſſiſippi is of more than ſeven hundred leagues in length, beginning at its ſource near the lake Aſſiniboils, and ending at its opening into the Gulph of Mexico. The river Plate runs a length of more than eight hundred leagues from its ſource in the river Parana, to its mouth. The river Oroonoko is ſeven hundred and fifty-five leagues in length, from its ſource near Paſto, to its diſcharge into the Atlantic ocean.

Such is the amazing length of the greateſt rivers; and even in ſome of theſe, the moſt remote ſources very probably yet continue unknown. In fact, if we conſider the number of rivers which they receive, and the little acquaintance we have with the regions through which they run, it is not to be wondered at that geographers are divided concerning the ſources of moſt of them. As among a number of roots by which nouriſhment is conveyed to a ſtately tree, it is difficult to determine preciſely that by which the tree is chiefly ſupplied; ſo among the many branches of a great river, it is equally difficult to tell which is the original. Hence it may eaſily happen, that a ſimilar branch is taken for the capital ſtream; and its runnings are purſued, and delineated, in prejudice of ſome other branch that better deſerved the name and the deſcription. In this manner, in Europe, the Danube is known to receive thirty leſſer rivers: the Wolga, thirty-two or thirty-three. In Aſia, the Hohanno receives thirty-five; the Jeniſca above ſixty; the Oby as many; the Amour about forty; the Nanquin receives thirty rivers; the Ganges twenty; and the Euphrates about eleven. In Africa, the Senegal receives more than twenty rivers; the Nile receives not one for five hundred leagues upwards, and then only twelve or thirteen. In America, the river Amazons receives above ſixty; and thoſe very conſiderable; the river St. Lawrence about forty, counting thoſe which fall into its lakes; the Miſſiſippi receives forty; and the river Plate above fifty.

We mentioned the inundations of the Ganges and the Nile, but almoſt every other great river whoſe ſource lies within the tropics, have their ſtated inundations alſo. The river Pegu has been called, by travellers, the Indian Nile, becauſe of the ſimilar overflowings of its ſtream: this it does to an extent of thirty leagues on each ſide; and ſo fertilizes the ſoil, that the inhabitants ſend great quantities of rice into other countries, and have ſtill abundance for their own conſumption. The river Senegal has likewiſe its inundations, which cover the whole flat country of Negroland, beginning and ending much about the ſame time with thoſe of the Nile; as, in fact, both rivers riſe from the ſame mountains. But the difference between the effects of the inundations in each river is remarkable: in the one, it diſtributes health and plenty; in the other, diſeaſes, famine, and death. The inhabitants along the torrid coaſts of the Senegal can receive no benefit from any additional manure the river may carry down to their ſoil, which is, by nature, more than ſufficiently luxuriant; or, even if they could, they have not induſtry to turn it to any advantage. The banks, therefore, of the rivers, lie uncultivated, overgrown with rank and noxious herbage, and infeſted with thouſands

fands of animals of various malignity. Every new flood only tends to increaſe the rankneſs of the ſoil, and to provide freſh ſhelter for the creatures that infeſt it. If the flood continues but a few days longer than uſual, the improvident inhabitants, who are driven up in the higher grounds, want proviſions, and a famine enſues. When the river begins to return into its channel, the humidity and heat of the air are equally fatal; and the carcaſes of infinite numbers of animals, ſwept away by the inundation, putrifying in the ſun, produce a ſtench that is almoſt inſupportable. But even the luxuriance of the vegetation becomes a nuiſance. We have been aſſured by perſons of veracity who have been up the river Seriegal, that there are ſome plants growing along the coaſt, the ſmell of which is ſo powerful, that it is hardly to be endured. It is certain, that all the ſailors and ſoldiers who have been at any of our factories there, aſcribe the unwholeſomeneſs of the voyage up the ſtream, to the vegetable vapour. However this be, the inundations of the rivers in this wretched part of the globe, contribute ſcarce any advantage, if we except to the beauty of the proſpects which they afford. Theſe, indeed, are finiſhed beyond the utmoſt reach of art: a ſpacious glaſſy river, with its banks here and there fringed to the very ſurface by the mangrove-tree, that grows down into the water, preſents itſelf to view. Lofty foreſts of various colours, with openings between, carpeted with green plants, and the moſt gaudy flowers; beaſts and animals, of various kinds, that ſtand upon the banks of the river, and, with a ſort of wild curioſity, ſurvey the mariners as they paſs, contribute to heighten the ſcene. This is the ſketch of an African proſpect; which delights the eye, even while it deſtroys the conſtitution.

Beſide theſe annually periodical inundations, there are many rivers that overflow at much ſhorter intervals. Thus moſt of thoſe in Peru and Chili have ſcarce any motion by night; but upon the appearance of the morning ſun, they reſume their former rapidity: this proceeds from the mountain ſnows, which melting with the heat, increaſe the ſtream, and continue to drive on the current while the ſun continues to diſſolve them. Some rivers alſo flow with an even ſteady current, from their ſource to the ſea; others flow with greater rapidity, their ſtream being poured down in a cataract, or ſwallowed by the ſands, before they reach the ſea.

The rivers of thoſe countries that have been leaſt inhabited, are uſually more rocky, uneven, and broken into water-falls or cataracts, than thoſe where the induſtry of man has been more prevalent. Wherever man comes, nature puts on a milder appearance: the terrible and the ſublime are exchanged for the gentle and the uſeful; the cataract is ſloped away into a placid ſtream; and the banks become more ſmooth and even. It muſt have required ages to render the Rhone or the Loir navigable; their beds muſt have been cleaned and directed; their inequalities removed; and, by a long courſe of induſtry, nature muſt have been taught to conſpire with the deſires of her controller. Every one's experience muſt have ſupplied inſtances of rivers thus being made to flow more evenly, and more beneficially to mankind; but there are ſome whoſe currents are ſo rapid, and falls ſo precipitate, that no art can obviate; and that muſt for ever remain as amazing inſtances of incorrigible nature.

Of this kind are the cataracts of the Rhine; one of which has been ſeen to exhibit a very ſtrange appearance: it was that at Schathauſen, which was frozen quite acroſs, and the water ſtood in columns where the cataract had formerly fallen. The Nile, as was ſaid, has its cataracts. The river Vologda, in Ruſſia, has two. The river Zara, in Africa, has one near its ſource. The river Velino, in Italy, has a cataract of above an hundred and fifty feet perpendicular. Near the city of Gottenburgh, in Sweden, the river ruſhes down from a prodigious high precipice into a deep pit, with a terrible noiſe, and ſuch dreadful force, that thoſe trees deſigned for the maſts of ſhips, which are floated down the river, are uſually turned upſide down in their fall, and often are ſhattered to pieces, by being daſhed againſt the ſurface of the water in the pit; this occurs if the maſts fall ſideways upon the water; but if they fall endways, they dive ſo far under water, that they diſappear for a quarter of an hour, or more: the pit into which they are thus plunged, has been often ſounded with a line of ſome hundred fathoms long, but no ground has been found hitherto. There is alſo a cataract at Powerſcourt, in Ireland, in which the water is ſaid to fall three hundred feet perpendicular; which is a greater deſcent than that of any other cataract in any part of the world. There is a cataract at Albany, in the province of New York, which pours its ſtream fifty feet perpendicular. But of all the cataracts in the world, that of Niagara, in Canada, if we conſider the great body of water that falls, muſt be allowed to be the greateſt, and the moſt aſtoniſhing.

This amazing fall of water is made by the river St. Lawrence, in its paſſage from the lake Erie into the lake Ontario. We have already ſaid that St. Lawrence was one of the largeſt rivers in the world; and yet the whole of its waters are here poured down, by a fall of an hundred and fifty feet perpendicular. It is not eaſy to bring the imagination to correſpond with the greatneſs of the ſcene; a river extremely deep and rapid, and that ſerves to drain the waters of almoſt all North America into the Atlantic ocean, is here poured precipitately down a ledge of rocks, that riſe, like a wall, acroſs the whole bed of its ſtream. The width of the river, a little above, is near three quarters of a mile broad, and the rocks, where it grows narrower, are four hundred yards over. Their direction is not ſtreight acroſs, but hollowing inwards like an horſe-ſhoe; ſo that the cataract, which bends to the ſhape of the obſtacle, rounding inwards, preſents a kind of theatre the moſt tremendous in nature. Juſt in the middle of this circular wall of waters, a little iſland, that has braved the fury of the current, preſents one of its points, and divides the ſtream at top into two; but it unites again long before it has got to the bottom. The noiſe of the fall is heard at ſeveral leagues diſtance; and the fury of the waters at the bottom of their fall is inconceivable. The daſhing produces a miſt that riſes to the very clouds; and that produces a moſt beautiful rainbow, when the ſun ſhines. It may eaſily be conceived, that ſuch a cataract quite deſtroys the navigation of the ſtream: and, yet ſome Indian canoes, as it is ſaid, have been known to venture down it with ſafety.

Of thoſe rivers that loſe themſelves in the ſands, or are ſwallowed up by chaſms in the earth, we have various information. What we are told by the ancients, of the river Alpheus, in Arcadia, that ſinks into the ground, and riſes again near Syracuſe, in Sicily, where it takes the name of Arethuſa, is rather more known than credited. But we have better information with reſpect to the river Tigris being loſt in this manner under Mount Taurus; of the Guadilquiver, in Spain, being buried in the ſands; of the river Greatah, in Yorkſhire, running underground, and riſing again, and even of the great Rhine itſelf, a part of which is no doubt loſt in the ſands, a little above Leyden. But it ought to be obſerved of this river, that by much the greateſt part arrives at the ocean; for,

although

although the ancient channel which fell into the ſea, a little to the weſt of that city, be now entirely choaked up, yet there are ſtill a number of ſmall canals, that carry a great body of waters to the ſea: and, beſides, it has alſo two very large openings, the Lech, and the Wal, below Rotterdam, by which it empties itſelf abundantly.

Be this as it will, nothing is more common in ſultry and ſandy deſerts, than rivers being thus either loſt in the ſands, or entirely dried up by the ſun. And hence we ſee, that under the Line, the ſmall rivers are but few, for ſuch little ſtreams as are common in Europe, and which with us receive the name of rivers, would quickly evaporate, in thoſe parching and extenſive deſerts. It is even confidently aſſerted, that the great river Niger is thus loſt before it reaches the ocean; and that its ſuppoſed mouths, the Gambia, and the Senegal, are diſtinct rivers, that come a vaſt way from the interior parts of the country. It appears, that the rivers under the Line are large; but it is otherwiſe at the Poles, where they muſt neceſſarily be ſmall. In that deſolate region, as the mountains are covered with perpetual ice, which melts but little, or not at all, the ſprings and rivulets are furniſhed with a very ſmall ſupply. Here, therefore, men and beaſts would periſh, and die for thirſt, if Providence had not ordered that in the hardeſt winter, thaws ſhould intervene, which depoſit a ſmall quantity of ſnow-water in pools under the ice; and from this ſource the wretched inhabitants drain a ſcanty beverage.

Thus, whatever quarter of the globe we turn to, we ſhall find new reaſons to be ſatisfied with that part of it in which we reſide. Our rivers furniſh all the plenty of the African ſtream, without its inundation; they have all the coolneſs of the Polar rivulet, with a more conſtant ſupply; they may want the terrible magnificence of huge cataracts, or extenſive lakes, but they are more navigable, and more tranſparent; though leſs deep and rapid than the rivers of the torrid zone, they are more manageable, and only wait the will of man to take their direction. The rivers of the torrid zone, like the monarchs of the country, rule with deſpotic tyranny, profuſe in their bounties, and ungovernable in their rage. The rivers of Europe, like their kings, are the friends, and not the oppreſſors of the people; bounded by known limits, abridged in the power of doing ill, directed by human ſagacity, and only at freedom to diſtribute happineſs and plenty.

CHAP. XV.

Of the OCEAN in general; and its Saltneſs.

IN looking upon a map of the world, we find that the ocean occupies conſiderably more of the globe, than the land is found to do. This immenſe body of waters is diffuſed round both the Old and New Continent, to the ſouth, and may ſurround them alſo to the north, for what we know, but the ice in thoſe regions has ſtopped our enquiries. Although the ocean, properly ſpeaking, is but one extenſive ſheet of waters, continued over every part of the globe, without interruption, and although no part of it is divided from the reſt, yet geographers have diſtinguiſhed it by different names; as the Atlantic or Weſtern Ocean, the Northern Ocean, the Southern Ocean, the Pacific Ocean, and the Indian Ocean. Others have divided it differently, and given other names, as the Frozen Ocean, the Inferior Ocean, or the American Ocean. But all theſe being arbitrary diſtinctions, and not of Nature's making, the naturaliſt may conſider them with indifference.

In this vaſt receptacle, almoſt all the rivers of the earth ultimately terminate; nor do ſuch great ſupplies ſeem to increaſe its ſtores; for it is neither apparently ſwollen by their tribute, nor diminiſhed by their failure; it ſtill continues the ſame. Indeed, what is the quantity of water of all the rivers and lakes in the world, compared to that contained in this great receptacle? If we ſhould offer to make a rude eſtimate, we ſhall find that all the rivers in the world, flowing into the bed of the ſea, with a continuance of their preſent ſtores, would take up at leaſt eight hundred years to fill it to its preſent height. For, ſuppoſing the ſea to be eighty-five millions of ſquare miles in extent, and a quarter of a mile, upon an average, in depth, this, upon calculation, will give above twenty-one millions of cubic miles of water, as the contents of the whole ocean. Now, to eſtimate the quantity of water which all the rivers ſupply, take any one of them; the Po, for inſtance, the quantity of whoſe diſcharge into the ſea, is known to be one cubic mile of water in twenty-ſix days. Now it will be found, upon a rude computation, from the quantity of ground the Po, with its influent ſtreams, covers, that all the rivers of the world furniſh about two thouſand times that quantity of water. In the ſpace of a year, therefore, they will have diſcharged into the ſea about twenty-ſix thouſand cubic miles of water; and not till eight hundred years will they have diſcharged as much water as is contained in the ſea at preſent. We have not troubled our readers with the odd numbers, leſt they ſhould imagine we were giving preciſion to a ſubject that is incapable of it.

Thus great is the aſſemblage of waters diffuſed round our habitable globe; and yet, immeaſurable as they ſeem, they are moſtly rendered ſubſervient to the neceſſities and the conveniencies of ſo little a being as man. Nevertheleſs, if it ſhould be aſked whether they be made for him alone, the queſtion is not eaſily reſolved. Some philoſophers have perceived ſo much analogy to man in the formation of the ocean, that they have not heſitated to aſſert its being made for him alone. The diſtribution of land and water, ſay they, is admirable; the one being laid againſt the other ſo ſkilfully, that there is a juſt equipoiſe of the whole globe. Thus the Northern Ocean balances againſt the Southern; and the New Continent is an exact counter-weight to the Old. As to any objection from the ocean's occupying too large a ſhare of the globe, they contend, that there could not have been a ſmaller ſurface employed to ſupply the earth with a due ſhare of evaporation. On the other hand, ſome take the gloomy ſide of the queſtion; they either magnify its apparent defects; or aſſert, that what ſeems defects to us, may be real beauties to ſome wiſer order of beings. They obſerve, that multitudes of animals are concealed in the ocean, and but a ſmall part of them are known; the reſt, therefore, they fail not to ſay, were certainly made for their own benefit, and not for ours. How far either of theſe opinions be juſt, we will not preſume to determine; but of this we are certain, that God has endowed us with abilities to turn this great extent of waters to our own advantage. He has made theſe things, perhaps, for other uſes; but he has given us faculties to convert them to our own. This much agitated queſtion, therefore, ſeems to terminate here. We ſhall never know whether the things of this world have been made for our uſe; but we very well know that we have been made to enjoy them. Let us then boldly affirm, that the earth, and all its wonders are ours; ſince we are furniſhed with powers to force them into our ſervice. Man is the lord of all the ſublunary creation; the howling ſavage, the winding ſerpent, with all the untameable and rebellious offspring of Nature, are deſtroyed in the conteſt, or driven at a diſtance from his habitations. The extenſive and tempeſtuous ocean, inſtead of limiting or dividing his

power, only ſerves to aſſiſt his induſtry, and enlarge the ſphere of his enjoyments. Its billows, and its monſters, inſtead of preſenting a ſcene of terror, only call up the courage of this little intrepid being; and the greateſt danger that man now fears on the deep, is from his fellow-creatures. Indeed, when we conſider the human race as Nature has formed them, there is but very little of the habitable globe that ſeems made for them. But when we conſider them as accumulating the experience of ages, in commanding the earth, there is nothing ſo great, or ſo terrible. What a poor contemptible being is the naked ſavage, ſtanding on the beach of the ocean, and trembling at its tumults! How little capable is he of converting its terrors into benefits; or of ſaying, behold an element made wholly for my enjoyment! He conſiders it as an angry deity, and pays it the homage of ſubmiſſion. But it is very different when he has exerciſed his mental powers; when he has learned to find his own ſuperiority, and to make it ſubſervient to his commands. It is then that his dignity begins to appear, and that the true Deity is juſtly praiſed for having been mindful of man; for having given him the earth for his habitation, and the ſea for an inheritance.

This power which man has obtained over the ocean, was at firſt enjoyed in common; and none pretended to a right in that element where all ſeemed intruders. The ſea, therefore, was open to all till the time of the emperor Juſtinian. His ſucceſſor Leo granted ſuch as were in poſſeſſion of the ſhore, the ſole right of fiſhing before their reſpective territories. The Thracian Boſphorus was the firſt that was thus appropriated; and from that time it has been the ſtruggle of moſt of the powers of Europe to obtain an excluſive right in this element. The Republic of Venice claims the Adriatic. The Danes are in poſſeſſion of the Baltic. But the Engliſh have a more extenſive claim to the empire of all the ſeas, encompaſſing the kingdoms of England, Scotland, and Ireland; and although theſe have been long conteſted, yet they are now conſidered as their indiſputable property. Every one knows that the great power of the nation is exerted on this element; and that the inſtant England ceaſes to be ſuperior upon the ocean, its ſafety begins to be precarious.

It is in ſome meaſure owing to our dependence upon the ſea, and to our commerce there, that we are ſo well acquainted with its extent and figure. The bays, gulphs, currents, and ſhallows of the ocean, are much better known and examined than the provinces and kingdoms of the earth itſelf. The hopes of acquiring wealth by commerce, has carried man to much greater length than the deſire of gaining information could have done. In conſequence of this, there is ſcarce a ſtrait or an harbour, ſcarce a rock or a quickſand, ſcarce an inflexion of the ſhore, or the jutting of a promontory, that has not been minutely deſcribed. But as theſe preſent very little entertainment to the imagination, or delight to any but thoſe whoſe purſuits are lucrative, they need not be dwelt upon here. While the merchant and the mariner are ſolicitous in deſcribing current and ſoundings, the naturaliſt is employed in obſerving wonders, though not ſo beneficial, yet to him of a much more important nature. The ſaltneſs of the ſea ſeems to be foremoſt.

Whence the ſea has derived that peculiar bitteriſh ſaltneſs which we find in it, appears, by Ariſtotle, to have exerciſed the curioſity of naturaliſts in all ages. He ſuppoſed (and mankind were for ages content with the ſolution) that the ſun continually raiſed dry ſaline exhalations from the earth, and depoſited them upon the ſea; and hence, ſay his followers, the waters of the ſea are more ſalt at top than at bottom. But, unfortunately for this opinion, neither of the facts is true. Sea ſalt is not to be raiſed by the vapours of the ſun; and ſea water is not ſalter at the top than at the bottom. Father Bohours is of opinion that the Creator gave the waters of the ocean their ſaltneſs at the beginning; not only to prevent their corruption, but to enable them to bear greater burthens. But their ſaltneſs does not prevent their corruption; for ſtagnant ſea-water, like freſh, ſoon grows putrid: and, as for their bearing greater burthens, freſh water anſwers all the purpoſes of navigation quite as well. The eſtabliſhed opinion, therefore, is that of Boyle, who ſuppoſes, "that the ſea's ſaltneſs is ſupplied not only from rocks or maſſes of ſalt at the bottom of the ſea, but alſo from the ſalt which the rains and rivers, and other waters, diſſolve in their paſſage through many parts of the earth, and at length carry with them to the ſea." But as there is a difference in the taſte of rock-ſalt found at land, and that diſſolved in the waters of the ocean, this may be produced by the plenty of nitrous and bituminous bodies that, with the ſalts, are likewiſe waſhed into that great receptacle. Theſe ſubſtances being thus once carried to the ſea, muſt for ever remain there; for they do not riſe by evaporation, ſo as to be returned back from whence they came. Nothing but the freſh waters of the ſea riſe in vapours; and all the ſaltneſs remains behind. From hence it follows, that every year the ſea muſt become more and more ſalt; and this ſpeculation Doctor Halley carries ſo far as to lay down a method of finding out the age of the world by the ſaltneſs of its waters. "For if it be obſerved," ſays he, "what quantity of ſalt is at preſent contained in a certain weight of water, taken up from the Caſpian Sea, for example, and, after ſome centuries, what greater quantity of ſalt is contained in the ſame weight of water, taken from the ſame place; we may conclude, that in proportion as the ſaltneſs has increaſed in a certain time, ſo much muſt it have increaſed before that time; and we may thus, by the rule of proportion, make an eſtimate of the whole time wherein the water would acquire the degree of ſaltneſs it ſhould be then poſſeſſed of." All this may be fine; however, an experiment, begun in this century, which is not to be completed till ſome centuries hence, is rather a little-mortifying to modern curioſity: and, we are induced to think, the inhabitants round the Caſpian Sea, will not be apt to undertake the enquiry.

This ſaltneſs is found to prevail in every part of the ocean; and as much at the ſurface as at the bottom. It is alſo found in all thoſe ſeas that communicate with the ocean; but rather in a leſs degree.

The great lakes, likewiſe, that have no outlets nor communication with the ocean, are found to be ſalt: but ſome of them in leſs proportion. On the contrary, all thoſe lakes through which rivers run into the ſea, however extenſive they be, are, notwithſtanding, very freſh: for the rivers do not depoſit their ſalts in the bed of the lake, but carry them, with their currents, into the ocean. Thus the lakes Ontario and Erie, in North America, although for magnitude they may be conſidered as inland ſeas, are, nevertheleſs, freſh water lakes; and kept ſo by the river St. Lawrence, which paſſes through them. But thoſe lakes that have no communication with the ſea, nor any rivers, going out, although they be leſs than the former, are, however, always ſalt. Thus, that which goes by the name of the Dead Sea, though very ſmall, when compared to thoſe already mentioned, is ſo exceedingly ſalt, that its waters ſeem ſcarce capable of diſſolving any more. The lakes of Mexico, and of Titicaca, in Peru, though of no great extent, are, nevertheleſs, ſalt; and both for the ſame reaſon.

Thoſe who are willing to turn all things to the beſt, have not failed to conſider this ſaltneſs of the ſea, as a peculiar bleſſing from Providence, in order

der to keep ſo great an element ſweet and wholeſome. What foundation there may be in the remark, we will not pretend to determine; but we ſhall ſhortly find a much better cauſe for its being kept ſweet, namely, its motion.

On the other hand, there have been many who have conſidered the ſubject in a different light, and have tried every endeavour to make ſalt-water freſh, ſo as to ſupply the wants of mariners in long voyages, or when exhauſted of their ordinary ſtores. At firſt it was ſuppoſed ſimple diſtillation would do; but it was ſoon found that the bitter part of the water ſtill kept mixed. It was then tried by uniting ſalt of Tartar with ſea-water, and diſtilling both: but here the expence was greater than the advantage. Calcined bones were next thought of; but an hogſhead of calcined bones, carried to ſea, would take up as much room as an hogſhead of water, and was more hard to be obtained. In this ſtate, therefore, have the attempts to ſweeten ſea-water reſted; the chymiſt ſatisfied with the reality of his invention; and the mariner convinced of its being uſeleſs. We cannot, therefore, avoid mentioning, a kind of ſuccedaneum which has been lately conceived to anſwer the purpoſes of freſh-water, when mariners are quite exhauſted. It is well known, the perſons who go into a warm bath, come out ſeveral ounces heavier than they went in; their bodies having imbibed a correſpondent quantity of water. This more particularly happens, if they have been previouſly debarred from drinking, or go in with a violent thirſt; which they quickly find quenched, and their ſpirits reſtored. It was ſuppoſed, that in caſe of a total failure of freſh-water at ſea, a warm bath might be made of ſea-water, for the uſe of mariners; and that their pores would thus imbibe the fluid, without any of its ſalts, which would be ſeen to cryſtallize on the ſurface of their bodies. In this manner, it is ſuppoſed, a ſufficient quantity of moiſture may be procured to ſuſtain life, till time or accident furniſh a more copious ſupply.

But, however this be, the ſaltneſs of the ſea can by no means be conſidered as a principal cauſe in preſerving its waters from putrefaction. The ocean has its currents, like rivers, which circulate its contents round the globe; and theſe may be ſaid to be the great agents that keep it ſweet and wholeſome. Its ſaltneſs alone would by no means anſwer this purpoſe: and ſome have even imagined, that the various ſubſtances with which it is mixed, rather tend to promote putreſcence then impede it. Sir Robert Hawkins, one of our moſt enlightened navigators, gives the following account of a calm, in which the ſea continuing for ſome time without motion, began to aſſume a very formidable appearance. "Were it not," ſays he, "for the moving of the ſea, by the force of winds, tides, and currents, it would corrupt all the world. The experiment of this I ſaw in the year 1590, lying with a fleet about the iſlands of Azores, almoſt ſix months; the greateſt part of which time we were becalmed. Upon which all the ſea became ſo repleniſhed with ſeveral ſorts of jellies, and forms of ſerpents, adders, and ſnakes, as ſeemed wonderful: ſome green, ſome black, ſome yellow, ſome white, ſome of divers colours, and many of them had life; and ſome there were an yard and an half and two yards long; which had I not ſeen, I could hardly have believed. And hereof are witneſſes all the company of the ſhips which were then preſent: ſo that hardly a man could draw a bucket of water clear of ſome corruption. In which voyage, towards the end thereof, many of every ſhip fell ſick, and began to die apace. But the ſpeedy paſſage into our country, was a remedy to the crazed, and a preſervative for thoſe that were not touched."

This ſhews, abundantly, how little the ſea's ſaltneſs was capable of preſerving it from putrefaction: but, to put the matter beyond all doubt, Mr. Boyle kept a quantity of ſea-water, taken up in the Engliſh channel, for ſome time barrelled up; and, in the ſpace of a few weeks, it began to acquire a fœtid ſmell: he was alſo aſſured by one of his acquaintance who was becalmed for twelve or fourteen days in the Indian ſea, that the water, for want of motion, began to ſtink; and that had it continued much longer, the ſtench would probably have poiſoned him. It is the motion, therefore, and not the ſaltneſs of the ſea, that preſerves it in its preſent ſtate of ſalubrity; and this, very probably, by daſhing and breaking in pieces the rudiments, if we may ſo call them, of the various animals that would otherwiſe breed there and putrefy.

There are ſome advantages, however, which are derived from the ſaltneſs of the ſea. Its waters being evaporated, furniſh that ſalt which is uſed for domeſtic purpoſes; and, although in ſome places it is made from ſprings, and, in others, dug out of mines, yet the greateſt quantity is made only from the ſea. That which is called bay-ſalt, (from its coming to us by the Bay of Biſcay) is a ſtronger kind, made by evaporation in the ſun: that called common ſalt, is evaporated in pans over the fire, and is of a much inferior quality to the former.

Another benefit ariſing from the quantity of ſalt diſſolved in the ſea, is, that it thus becomes heavier, and, conſequently, more buoyant. Mr. Boyle, who examined the difference between ſea-water and freſh, found that the former appeared to be about a forty-fifth part heavier than the latter. Thoſe, alſo, who have had opportunities of bathing in the ſea, pretend to have experienced a much greater eaſe in ſwimming there, than in freſh water. However, as we ſee they have only a forty-fifth part more of their weight ſuſtained by it, we are apt to doubt whether ſo minute a difference can be practically perceivable. Be this as it may, as ſea-water alters in its weight from freſh, ſo it is found alſo to differ from itſelf in different parts of the ocean. In general, it is perceived to be heavier, and, conſequently, ſalter, the nearer we approach the Line.

But there is an advantage ariſing from the ſaltneſs of the waters of the ſea, much greater than what has been yet mentioned; which is, that their congelation is thus retarded. Some, indeed, have gone ſo far as to ſay, that ſea-water never freezes: but this is an aſſertion contradicted by experience. However, it is certain that it requires a much greater degree of cold to freeze it than freſh water; ſo that, while rivers and ſprings are ſeen converted into one ſolid body of ice, the ſea is always fit for navigation, and no way affected by the coldneſs of the ſevereſt winter. It is, therefore, one of the greateſt bleſſings we derive from this element, that when at land all the ſtores of Nature are locked up from us, we find the ſea ever open to our neceſſities, and patient of the hand of induſtry.

But it muſt not be ſuppoſed, becauſe in our temperate climate we never ſee the ſea frozen, that it is in the ſame manner open in every part of it. A very little acquaintance with the accounts of mariners, muſt have informed us, that at the polar regions it is embarraſſed with mountains, and moving ſheets of ice, that often render it impaſſable. Theſe tremendous floats are of different magnitudes; ſometimes riſing more than a thouſand feet above the ſurface of the water; ſometimes diffuſed into plains of above two hundred leagues in length; and, in many parts, ſixty or eighty broad. They are uſually divided by fiſſures; one piece following another ſo cloſe, that a perſon may ſtep from one to the other. Sometimes mountains are ſeen riſing amidſt theſe plains, and preſenting the appearance of

of a variegated landſcape, with hills and valleys, houſes, churches, and towers. Theſe are appearances in which all naturaliſts are agreed; but the great conteſt is reſpecting their formation. Mr Buffon aſſerts, that they are formed from freſh water alone; which congealing at the mouths of great rivers, accumulate thoſe huge maſſes that diſturb navigation. However, this great naturaliſt ſeems not to have been aware that there are two ſorts of ice floating in theſe ſeas; the flat ice, and the mountain ice: the one formed of ſea-water only; the other, of freſh.

The flat, or driving ice, is entirely compoſed of ſea-water; which, upon diſſolution, is found to be ſalt; and is readily diſtinguiſhed from the mountain or freſh-water ice, by its whiteneſs, and want of tranſparency. This ice is much more terrible to mariners than that which riſes up in lumps: a ſhip can avoid the one, as it is ſeen at a diſtance; but it often gets in among the other, which ſometimes cloſing, cruſhes it to pieces. This, which manifeſtly has a different origin from the freſh-water ice, may perhaps have been produced in the Icy Sea, beneath the Pole; or along the coaſts of Spitzberg, or Nova Zembla.

The mountain-ice, as was ſaid, is different in every reſpect, being formed of freſh water, and appearing hard and tranſparent; it is generally of a pale green colour, though ſome pieces are of a beautiful ſky blue; many large maſſes, alſo, appear grey; and ſome black. If examined more nearly, they are found to be incorporated with earth, ſtones, and bruſh-wood waſhed from the ſhore. On theſe alſo are ſometimes found, not only earth, but neſts with bird eggs, at ſeveral hundred miles from land. The generality of theſe, though almoſt totally freſh, have, nevertheleſs, a thick cruſt of ſalt-water frozen upon them, probably from the power that ice has ſometimes to produce ice. Such mountains as are here deſcribed, are moſt uſually ſeen at ſpring-time, and after a violent ſtorm, driving out to ſea, where they at firſt terrify the mariner, and are ſoon after daſhed to pieces by the continual waſhing of the waves; or driven into the warmer regions of the ſouth, there to be melted away. They ſometimes, however, ſtrike back upon their native ſhores, where they ſeem to take root at the feet of mountains; and, as Martius tells us, are ſometimes higher than the mountains themſelves. Thoſe ſeen by him were blue, full of clefts and cavities made by the rain, and crowned with ſnow, which alternately thawing and freezing every year, augmented their ſize. Theſe, compoſed of materials more ſolid than that driving at ſea, preſented a variety of agreeable figures to the eye, that, with a little help from fancy, aſſumed the appearance of trees in bloſſom; the inſide of churches, with arches, pillars, and windows; and the blue coloured rays, darting from within, preſented the reſemblance of a glory.

If we enquire into the origin and formation of theſe, which, as we ſee, are very different from the former, we have a very ſatisfactory account of them in Krantz's Hiſtory of Greenland; and we will give the paſſage, with a very few alterations. "Theſe mountains of ice," ſays he, "are not ſalt, like the ſea-water, but ſweet; and, therefore, can be formed no where except on the mountains, in rivers, in caverns, and againſt the hills near the ſea-ſhore. The mountains of Greenland are ſo high, that the ſnow which falls upon them, particularly on the north-ſide, is, in one night's time, wholly converted into ice: they alſo contain clefts and cavities, where the ſun ſeldom or never injects his rays: beſides theſe, are projections, or landing-places, on the declivities of the ſteepeſt hills, where the rain and ſnow-water lodge, and quickly congeal. When now the accumulated flakes of ſnow ſlide down, or fall with the rain from the eminences above, on theſe prominences; or, when here and there a mountain-ſpring comes rolling down to ſuch a lodging place, where the ice has already ſeated itſelf, they all freeze, and add their tribute to it. This, by degrees, waxes to a body of ice, that can no more be overpowered by the ſun; and which, though it may indeed, at certain ſeaſons, diminiſh by a thaw, yet, upon the whole, through annual acquiſitions, it aſſumes an annual growth. Such a body of ice is often prominent far over the rocks. It does not melt on the upper ſurface, but underneath; and often cracks into many larger or ſmaller clefts, from whence the thawed water trickles out. By this, it becomes, at laſt, ſo weak, that being overloaded with its own ponderous bulk, it breaks looſe, and tumbles down the rocks with a terrible craſh. Where it happens to overhang a precipice on the ſhore, it plunges into the deep with a ſhock like thunder; and with ſuch an agitation of the water, as will overſet a boat at ſome diſtance, as many a poor Greenlander has fatally experienced. Thus are theſe amazing ice mountains launched forth to ſea, and found floating in the waters round both the Poles. It is theſe that have hindered mariners from diſcovering the extenſive countries that lie round the South Pole; and that probably block up the paſſage to China by the North.

We will conclude this chapter with one effect more, produced by the ſaltneſs of the ſea; which is, the luminous appearance of its waves in the night. All who have been ſpectators of a ſea by night, a little ruffled with winds, ſeldom fail of obſerving its fiery brightneſs. In ſome places it ſhines as far as the eye can reach; at other times, only when the waves boom againſt the ſide of the veſſel, or the oar daſhes into the water. Some ſeas ſhine often; others more ſeldom; ſome, ever when particular winds blow; and others, within a narrow compaſs; a long tract of light being ſeen along the ſurface, whilſt all the reſt is hid in total darkneſs. It is not eaſy to account for theſe extraordinary appearances: ſome have ſuppoſed that a number of luminous inſects produced the effect, and this is in reality ſometimes the caſe; in general, however, they have every reſemblance to that light produced by electricity; and, probably, ariſe from the agitation and daſhing of the ſaline particles of the fluid againſt each other. But the manner in which this is done, for we can produce nothing ſimilar by any experiments hitherto made, remains for ſome happier accident to diſcover. Our progreſs in the knowledge of nature is ſlow; and it is a mortifying conſideration, that we are hitherto more indebted for ſucceſs to chance than induſtry.

CHAP. XVI.

Of the Tides, Motion, and Currents of the Sea; with their Effects.

IT was ſaid, in the former chapter, that the waters of the ſea were kept ſweet by their motion; without which they would ſoon putrefy, and ſpread univerſal infection. If we look for final cauſes, here, indeed, we have a great and an obvious one that preſents itſelf before us. Had the ſea been made without motion, and reſembling a pool of ſtagnant water, the nobler races of animated nature would ſhortly be at an end. Nothing would then be left alive but ſwarms of ill-formed creatures, with ſcarce more than vegetable life; and ſubſiſting by putrefaction. Were this extenſive bed of waters entirely quieſcent, millions of the

smaller reptile kinds would there find a proper re-sort to breed and multiply in; they would find there no agitation, no concuſſion in the parts of the fluid to cruſh their feeble frames, or to force them from the places where they were bred: there they would multiply in ſecurity and eaſe, enjoy a ſhort life, and putrifying, thus again give nouriſhment to numberleſs others, as little worthy of exiſtence as themſelves. But the motion of this great element effectually deſtroys the number of theſe vile creatures; its currents and its tides produce continual agitations, the ſhock of which they are not able to endure; the parts of the fluid rub againſt each other, deſtroy all viſcidities; and the ocean, if we may ſo expreſs it, acquires health by exerciſe.

The moſt obvious motion of the ſea, and the moſt generally acknowledged, is that of its tides. This element is obſerved to flow for certain hours, from ſouth towards the north; in which motion of flux, which laſts about ſix hours, the ſea gradually ſwells; ſo that entering the mouths of rivers, it drives back the river waters to their heads. After a continual flux of ſix hours, the ſea ſeems to reſt for a quarter of an hour; and then begins to ebb, or retire back again, from north to ſouth, for ſix hours more; in which time the waters ſinking, the rivers reſume their natural courſe. After a ſeeming pauſe of a quarter of an hour, the ſea again begins to flow as before: and thus it has alternately riſen and fallen, twice a day, ſince the creation.

This amazing appearance did not fail to excite the curioſity, as it did the wonder of the ancients. After ſome wild conjectures of the earlieſt philoſophers, it became well known, in the times of Pliny, that the tides were entirely under the influence, in a ſmall degree, of the ſun; but in a much greater of the moon. It was found that there was a flux and reflux of the ſea, in the ſpace of twelve hours fifty minutes, which is exactly the time of a lunar day. It was obſerved, that whenever the moon was in the meridian, or, in other words, as nearly as poſſible over any part of the ſea, that the ſea flowed to that part, and made a tide there; on the contrary, it was found, that when the moon left the meridian, the ſea began to flow back again from whence it came; and there might be ſaid to ebb. Thus far the waters of the ſea ſeemed very regularly to attend the motions of the moon. But as it appeared, likewiſe, that when the moon was in the oppoſite meridian, as far off on the other ſide of the globe, that there was a tide on this ſide alſo; ſo that the moon produced two tides, one by her greateſt approach to us, and another by her greateſt diſtance from us: in other words, the moon, in once going round the earth, produced two tides, always at the ſame time; one on the part of the globe directly under her; and the other on the part of the globe directly oppoſite.

Mankind continued for ſeveral ages content with knowing the general cauſe of theſe wonders, hopeleſs of diſcovering the particular manner of the moon's operation. Kepler was the firſt who conjectured that attraction was the principal cauſe; aſſerting that the ſphere of the moon's operation extended to the earth, and drew up its waters. The preciſe manner in which this is done, was diſcovered by Newton.

The moon has been found, like all the reſt of the planets, to attract, and to be attracted by the earth. This attraction prevails throughout our whole planetary ſyſtem. The more matter there is contained in any body, the more it attracts: and its influence decreaſes in proportion as the diſtance, when ſquared, increaſes. This being premiſed, let us ſee what muſt enſue upon ſuppoſing the moon in the meridian of any tract of the ſea. The ſurface of the water immediately under the moon, is nearer the moon than any other part of the globe is; and, therefore, muſt be more ſubject to its attraction than the waters any where elſe. The waters will, therefore, be attracted by the moon, and riſe in an heap; whoſe eminence will be the higheſt, where the attraction is greateſt. In order to form this eminence, it is obvious that the ſurface, as well as the depths, will be agitated; and that wherever the water runs from one part, ſucceeding waters muſt run to fill up the ſpace it has left. Thus the waters of the ſea, running from all parts, to attend the motions of the moon, produce the flowing of the tide; and it is high tide at that part wherever the moon comes over it, or to its meridian.

But when the moon travels onward, and ceaſes to point over the place where the waters were juſt riſen, the cauſe here of their riſing ceaſing to operate, they will flow back by their natural gravity, into the lower parts from whence they had travelled; and this retiring of the waters will form the ebbing of the ſea.

Thus the firſt part of the demonſtration is obvious; ſince, in general, it requires no great ſagacity to conceive that the waters neareſt the moon are moſt attracted, or raiſed higheſt by the moon. But the other part of the demonſtration, namely, how there come to be high tides at the ſame time, on the oppoſite ſide of the globe, and where the waters are fartheſt from the moon, is not ſo eaſy to conceive. To comprehend this, it muſt be obſerved, that the part of the earth, and its waters, that are fartheſt from the moon, are the parts of all others that are leaſt attracted by the moon: it muſt alſo be obſerved, that all the waters, when the moon is on the oppoſite ſide of the earth, muſt be attracted by it in the ſame direction that the earth itſelf attracts them; that is, quite through the body of the earth, towards the moon itſelf. This, therefore, being conceived, it is plain that thoſe waters which are fartheſt from the moon, will have leſs weight than thoſe of any other part, on the ſame ſide of the globe; becauſe the moon's attraction, which conſpires with the earth's attraction, is there leaſt. Now, therefore, the waters fartheſt from the moon, having leſs weight, and being lighteſt, will be preſſed on all ſides, by thoſe that, having more attraction, are heavier; and the heavier waters flowing in, will make them ſwell and riſe in an eminence directly oppoſite to that on the other ſide of the globe, cauſed by the more immediate influence of the moon.

In this manner the moon, in one diurnal revolution, produces two tides; one raiſed immediately under the ſphere of its influence, and the other directly oppoſite to it. As the moon travels, this vaſt body of waters rears upward, as if to watch its motions; and purſues the ſame conſtant rotation. However, in this great work of raiſing the tides, the ſun has no ſmall ſhare; it produces its own tides conſtantly every day, juſt as the moon does, but in a much leſs degree, becauſe the ſun is at an immenſely greater diſtance. Thus there are ſolar tides, and lunar tides. When the forces of theſe two great luminaries concur, which they always do when they are either in the ſame, or in oppoſite parts of the heavens, they jointly produce a much greater tide, than when they are ſo ſituated in the heavens, as each to make peculiar tides of their own. To expreſs the very ſame thing technically; in the conjunctions and oppoſitions of the ſun and moon, the attraction of the ſun conſpires with the attraction of the moon; by which means the high ſpring-tides are formed. But in the quadratures of the ſun and moon, the water raiſed by the one is depreſſed by the other; and hence the lower neap-tides have their production. In a word, the tides are greateſt in the ſyzigies, and leaſt in the quadratures.

This theory well underſtood, and the aſtronomical terms previouſly known, it may readily be brought to explain the various appearances of the tides, if the earth were covered with a deep ſea, and the waters uninfluenced by ſhoals, currents, ſtraits, or tempeſts. But in every part of the ſea, near the ſhores, the geographer muſt come in to correct the calculations of the aſtronomer. For, by reaſon of the ſhallowneſs of ſome places, and the narrowneſs of the ſtraits in others, there ariſes a great diverſity in the effect, not to be accounted for without an exact knowledge of all the circumſtances of the place. In the great depths of the ocean, for inſtance, a very ſlow and impereeptible motion of the whole body of water will ſuffice to raiſe its ſurface ſeveral feet high; but if the ſame increaſe of water is to be conveyed through a narrow channel, it muſt ruſh through it with the moſt impetuous rapidity. Thus, in the Engliſh channel, and the German ocean, the tide is found to flow ſtrongeſt in thoſe places that are harroweſt; the ſame quantity of water being, in this caſe, driven through a ſmaller paſſage. It is often ſeen, therefore, pouring through a ſtreight with great force; and, by its rapidity, conſiderably raiſed above the ſurface of that part of the ocean into which it runs.

This ſhallowneſs and narrowneſs in many parts of the ſea, give alſo riſe to a peculiarity in the tides of ſome parts of the world. For in many places, and in our own ſeas in particular, the greateſt ſwell of the tide is not while the moon is in its meridian height, and directly over the place, but ſome time after it has declined from thence. The ſea, in this caſe, being obſtructed, purſues the moon with what diſpatch it can, but does not arrive with all its waters till long after the moon has ceaſed to operate. Laſtly, from this ſhallowneſs of the ſea, and from its being obſtructed by ſhoals and ſtreights, we may account for the Mediterranean, the Baltic, and the Black Sea, having no ſenſible tides. Theſe, though to us they ſeem very extenſive, are not however large enough to be affected by the influence of the moon; and as to their communication with the ocean, through ſuch narrow inlets, it is impoſſible in a few hours they ſhould receive and return water enough to raiſe or depreſs them in any conſiderable degree.

In general we may obſerve, that all tides are much higher, and more conſiderable in the torrid zone, than in the reſt of the ocean; the ſea in thoſe parts being generally deeper, and leſs affected by changeable winds, or winding ſhores. The greateſt tide we know of, is that at the mouth of the river Indus, where the water riſes thirty feet in height. How great, therefore, muſt have been the amazement of Alexander's ſoldiers at ſo ſtrange an appearance! They who always before had been accuſtomed only to the ſcarcely perceptible riſings of the Mediterranean, or the minute intumeſcence of the Black Sea, when made at once ſpectators of a river riſing and falling thirty feet in a few hours, muſt no doubt have felt the moſt extreme awe, and (as Quintus Curtius tells us) a mixture of curioſity and apprehenſion. The tides are alſo remarkably high on the coaſts of Malay, in the ſtreights of Sunda, in the Red Sea, at the mouth of the river St. Lawrence, along the coaſts of China and Japan, at Panama, and in the gulph of Bengal. The tides at Tonquin, however, are the moſt remarkable in the world. In this part there is but one tide, and one ebb, in twenty-four hours; whereas, as we have ſaid before, in other places there are two. Beſides, there, twice in each month there is no tide at all, when the moon is near the equinoctial, the water being for ſome time quite ſtagnant. Theſe, with ſome other odd appearances attending the ſame phænomena, were conſidered by many as inexplicable; but Sir Iſaac Newton, with peculiar ſagacity, judged them to ariſe from the concurrence of two tides, one from the South Sea, and the other from the Indian Ocean. Of each of theſe tides there come ſucceſſively two every day; two at one time greater, and two at another that are leſs. The time between the arrival of the two greater, is conſidered by him as high tide; the time between the two leſſer, as ebb. In ſhort, with this clue, that great mathematician ſolved every appearance, and ſo eſtabliſhed his theory as to ſilence every oppoſer.

This fluctuation of the ſea from the tides, produces another, and more conſtant rotation of its waters, from the eaſt to the weſt, in this reſpect following the courſe of the moon. This may be conſidered as one great and general current of the waters of the ſea; and although it be not every where diſtinguiſhable, it is nevertheleſs every where exiſtent, except when oppoſed by ſome particular current or eddy, produced by partial and local cauſes. This tendency of the ſea towards the weſt, is plainly perceivable in all the great ſtreights of the ocean; as, for inſtance, in thoſe of Magellan, where the tide running in from the eaſt, riſes twenty feet high, and continues flowing ſix hours; whereas the ebb continues but two hours, and the current is directed to the weſt. This proves that the flux is not equal to the reflux; and that from both reſults a motion of the ſea weſtward, which is more powerful during the time of the flux than the reflux.

But this motion weſtward has been ſenſibly obſerved by navigators, in their paſſage back from India to Madagaſcar, and ſo on to Africa. In the great Pacific Ocean alſo it is very perceivable: but the places where it is moſt obvious are, as was ſaid, in thoſe ſtreights which join one ocean to another. In the ſtreights between the Maldivia iſlands, in the gulph of Mexico, between Cuba and Jucatan, In the ſtreights of the gulph of Paria, the motion is ſo violent, that it hath received the appellation of the Dragon's Mouth. Northward, in the ſea of Canada, in Waigat's ſtreights, in the ſtreights of Java, and, in ſhort, in every ſtreight where the ocean on one part pours into the ocean on the other. In this manner, therefore, is the ſea carried with an unceaſing circulation round the globe; and, at the ſame time, that its waters are puſhed back and forward with the tide, they have thus a progreſſive current to the weſt, which, though leſs obſervable, is not the leſs real.

Beſides theſe two general motions of the ſea, there are others which are particular to many parts of it, and are called currents. Theſe are found to run in all directions, eaſt, weſt, north, and ſouth; being formed, as was ſaid above, by various cauſes; the prominence of the ſhores, the narrowneſs of the ſtreights, the variations of the wind, and the inequalities at the bottom. Theſe, though no great object to the philoſopher, as their cauſes are generally local and obvious, are nevertheleſs of the moſt material conſequence to the mariner; and, without a knowledge of which, he could never ſucceed. It often has happened, that when a ſhip has unknowingly got into one of theſe, every thing ſeems to go forward with ſucceſs, the mariners ſuppoſe themſelves every hour approaching their wiſh'd-for port, the wind fills their ſails, and the ſhip's prow ſeems to divide the water; but, at laſt, by miſerable experience they find, that inſtead of going forward, they have been all the time receding. The buſi- of currents, therefore, makes a conſiderable article in navigation; and the direction of their ſtream, and their rapidity, has been carefully ſet down. This ſome do by the obſervation of the ſurface of the current; or by the driving of the froth along the ſhore; or by throwing out what is called the log-

log-line, with a buoy made for that purpoſe: and by the direction and motion of this, they judge of the ſetting, and the rapidity of the current.

Theſe currents are generally found to be moſt violent under the equator, where indeed all the motions of the ocean are moſt perceivable. Along the coaſts of Guinea, if a ſhip happens to overſhoot the mouth of any river it is bound to, the current prevents its return; ſo that it is obliged to ſteer out to ſea, and take a very large compaſs, in order to correct the former miſtake. Theſe ſet in a contrary direction to the general motion of the ſea weſtward; and that ſo ſtrongly, that a paſſage which with the current is made in two days, is with difficulty performed in ſix weeks againſt it. However, they do not extend above twenty leagues from the coaſt; and ſhips going to the Eaſt-Indies, take care not to come within the ſphere of their action. At Sumatra, the currents, which are extremely rapid, run from ſouth to north: there are alſo ſtrong currents between Madagaſcar and the Cape of Good Hope. On the weſtern coaſts of America, the current always runs from the ſouth to the north, where a ſouth wind, continually blowing, moſt probably occaſions this phænomenon. But the currents that are moſt remarkable, are thoſe continually flowing into the Mediterranean ſea, both from the ocean by the ſtreights of Gibraltar, and at its other extremity, from the Euxine ſea by the Archipelago. This is one of the moſt extraordinary appearances in nature, this large ſea receiving not only the numerous rivers that fall into it, ſuch as the Nile, the Rhone, and the Po, but alſo a very great influx from the Euxine ſea on one part, and the ocean on the other. At the ſame time, it is ſeen to return none of thoſe waters it is thus known to receive: outlets running from it there are none; no rivers but ſuch as bring it freſh ſupplies; no ſtreights but what are conſtantly pouring their waters into it. It has therefore been the wonder of mankind in every age, how and by what means this vaſt concourſe of waters are diſpoſed of; or how this ſea, which is always receiving, and never returning, is no way fuller than before. In order to account for this, ſome have ſaid, that the water was re-conveyed by ſubterraneous paſſages into the Red Sea. There is a ſtory told of an Arabian cailiff, who caught a dolphin in this ſea, admiring the beauty of which, he let it go again, having previouſly marked it by a ring of iron. Some time after a dolphin was caught in the Red Sea, and quickly known by the ring to be the ſame that had been taken in the Mediterranean before. Such, however, as have not been willing to found their opinions upon a ſtory, have attempted to account for the diſpoſal of the waters of the Mediterranean by evaporation. For this purpoſe they have entered into long calculations upon the extent of its ſurface, and the quantity of water that would be raiſed from ſuch a ſurface in a year. They then compute how much water runs in by its rivers and ſtreights in that time; and find, that the quantity exhauſted by evaporation greatly exceeds the quantity ſupplied by rivers and ſeas. This ſolution, no doubt, would be ſatisfactory, did not the ocean, and the Euxine, evaporate as well as the Mediterranean: and as theſe are ſubject to the ſame drain, it muſt follow, that all the ſeas will in this reſpect be upon a par; and, therefore, there muſt be ſome other cauſe for this unperceived drain, and continual ſupply. This ſeems to be ſatisfactorily enough accounted for by Doctor Smith, who ſuppoſes an under current running through the ſtreights of Gibraltar to carry out as much water into the ocean, as the upper current continually carries in from it. To confirm this, he obſerves, that nearer home, between the north and ſouth Foreland, the tide is known to run one way at top, and the ebb another way at bottom. This double current he alſo confirms by an experiment communicated to him by an able ſeaman, who being with one of the king's frigates in the Baltic, found he went with his boat into the mid-ſtream, and was carried violently by the current; upon which a baſket was ſunk, with a large cannon-ball, to a certain depth of water, which gave a check to the boat's motion; as the baſket ſunk ſtill lower, the boat was driven, by the force of the water below, againſt the upper current; and the lower the baſket was ſet down, the ſtronger the under current was found, and the quicker was the boat's motion againſt the upper ſtream, which ſeemed not to be above four fathom deep. From hence we may readily infer, that the ſame cauſe may operate at the ſtreights of Gibraltar; and that while the Mediterranean ſeems repleniſhing at top, it may be emptying at bottom.

The number of the currents at ſea are impoſſible to be recounted; nor indeed are they always known; new ones are daily produced by a variety of cauſes, and as quickly diſappear. When a regular current is oppoſed by another in a narrow ſtreight, or where the bottom of the ſea is very uneven, a whirlpool is often formed. Theſe were formerly conſidered as the moſt formidable obſtructions to navigation, and the ancient poets and hiſtorians ſpeak of them with terror; they are deſcribed as ſwallowing up ſhips, and daſhing them againſt the rocks at the bottom: apprehenſion did not fail to add imaginary terrors to the deſcription, and placed at the center of the whirlpool a dreadful den, fraught with monſters whoſe howlings ſerved to add new horrors to the daſhings of the deep. Mankind at preſent, however, view theſe eddies of the ſea with very little apprehenſion; and ſome have wondered how the ancients could have ſo much overcharged their deſcriptions. But all this is very naturally accounted for. In thoſe times when navigation was in its infancy, and the ſlighteſt concuſſion of the waves generally ſent the poor adventurer to the bottom, it is not to be wondered at that he was terrified at the violent agitations in one of theſe. When his little ſhip, but ill fitted for oppoſing the fury of the ſea, was got within the vortex, there was then no poſſibility of ever returning. To add to the fatality, they were always near the ſhore; and along the ſhore was the only place where this ill provided mariner durſt venture to ſail. Theſe were, therefore, dreadful impediments to his navigation; for if he attempted to paſs between them and the ſhore, he was ſometimes ſucked in by the eddy; and if he attempted to avoid them out at ſea, he was often ſunk by the ſtorm. But in our time, and in our preſent improved ſtate of navigation, Charybdis, and the Euripus, with all the other irregular currents of the Mediterranean, are no longer formidable. Mr. Addiſon, not attending to this train of thinking, upon paſſing through the ſtreights of Sicily, was ſurpriſed at the little there was of terror in the preſent appearance of Sylla and Charybdis; and ſeems to be of opinion, that their agitations are much diminiſhed ſince the times of antiquity. In fact, from the reaſons above, all the wonders of the Mediterranean ſea are deſcribed in much higher colours than they merit, to us who are acquainted with the more magnificent terrors of the ocean. The Mediterranean is one of the ſmoothеſt and moſt gentle ſeas in the world; its tides are ſcarce perceivable, except in the gulph of Venice, and ſhipwrecks are leſs known there than in any other part of the world.

It is in the ocean, therefore, that theſe whirlpools are particularly dangerous, where the tides are violent, and the tempeſts fierce. To mention

only

only one, that called the Maelſtroom upon the coaſts of Norway, which is conſidered as the moſt dreadful and voracious in the world. The name it has received from the natives, ſignifies the navel of the ſea, ſince they ſuppoſe that a great ſhare of the water of the ſea is ſucked up and diſcharged by its vortex. A minute deſcription of the internal parts is not to be expected, ſince none who were there ever returned to bring back information. The body of the waters that form this whirlpool, are extended in a circle above thirteen miles in circumference. In the midſt of this ſtands a rock, againſt which the tide in its ebb is daſhed with inconceivable fury. At this time it inſtantly ſwallows up all things that come within the ſphere of its violence, trees, timber, and ſhipping. No ſkill in the mariner, nor ſtrength of rowing, can work an eſcape: the ſailor at the helm finds the ſhip at firſt go in a current oppoſite to his intentions: his veſſel's motion, though ſlow in the beginning, becomes every moment more rapid; it grows round in circles ſtill narrower and narrower, till at laſt it is daſhed againſt the rocks, and inſtantly diſappears: nor is it ſeen again for ſix hours: till the tide flowing, it is vomited forth with the ſame violence with which it was drawn in. The noiſe of this dreadful vortex ſtill farther contributes to increaſe its terror, which with the daſhing of the waters, and the dreadful valley, if it may be ſo called, cauſed by their circulation, makes one of the moſt tremendous objects in nature.

CHAP. XVII.

Of the Changes produced by the Sea upon the Earth.

FROM what has been ſaid, as well of the earth as of the ſea, they both appear to be in continual fluctuation. The earth, the common promptuary that ſupplies ſubſiſtence to men, animals, and vegetables, is continually furniſhing its ſtores to their ſupport. But the matter which is thus derived from it, is ſoon reſtored and laid down again to be prepared for freſh mutations. The tranſmigration of ſouls is no doubt falſe and whimſical; but nothing can be more certain than the tranſmigration of bodies: the ſpoils of the meaneſt reptile may go to the formation of a prince; and, on the contrary, as the poet has it, the body of Cæſar may be employed in ſtopping a beer-barrel. From this, and other cauſes, therefore, the earth is in continual change. Its internal fires, the deviation of its rivers, and the falling of its mountains, are daily altering its ſurface; and geography can ſcarce recollect the lakes and the valleys that hiſtory once deſcribed.

But theſe changes are nothing to the inſtability of the ocean. It would ſeem that inquietude was as natural to it as its fluidity. It is firſt ſeen with a conſtant and equable motion going towards the weſt; the tides then interrupt this progreſſion, and for a time drive the waters in a contrary direction; beſide theſe agitations, the currents act their part in a ſmaller ſphere, being generally greateſt where the other motions of the ſea are leaſt; namely, neareſt the ſhore: the winds alſo contribute their ſhare in this univerſal fluctuation; ſo that ſcarce any part of the ſea is wholly ſeen to ſtagnate.

As this great element is thus changed, and continually labouring internally, it may be readily ſuppoſed that it produces correſpondent changes upon its ſhores, and thoſe parts of the earth ſubject to its influence. In fact, it is every day making conſiderable alterations, either by overflowing its ſhores in one place, or deſerting them in others; by covering over whole tracts of country, that were cultivated and peopled, at one time; or by leaving its bed to be appropriated to the purpoſes of vegetation, and to ſupply a new theatre for human induſtry at another.

In this ſtruggle between the earth and the ſea for dominion, the greateſt number of our ſhores ſeem to defy the whole rage of the waves, both by their height, and the rocky materials of which they are compoſed. The coaſts of Italy, for inſtance, are bordered with rocks of marble of different kinds; the quarries of which may eaſily be diſtinguiſhed at a diſtance from ſea, and appear like perpendicular columns, of the moſt beautiful kinds of marble, ranged along the ſhore. In general, the coaſts of France, from Breſt to Bourdeaux, are compoſed of rocks; as are alſo thoſe of Spain and England, which defend the land, and only are interrupted, here and there, to give an egreſs to rivers, and to grant the conveniencies of bays and harbours to our ſhipping. It may be in general remarked, that wherever the ſea is moſt violent and furious, there the boldeſt ſhores, and of the moſt compact materials, are found to oppoſe it. There are many ſhores ſeveral hundred feet perpendicular, againſt which the ſea, when ſwollen with tides or ſtorms, riſes and beats with inconceivable fury. In the Orkneys, where the ſhores are thus formed, it ſometimes, when agitated by a ſtorm, riſes two hundred feet perpendicular, and daſhes up its ſpray, together with ſand, and other ſubſtances that compoſe its bottom, upon land, like ſhowers of rain.

From hence, therefore, we may conceive how the violence of the ſea, and the boldneſs of the ſhore, may be ſaid to have made each other. Where the ſea meets no obſtacles, it ſpreads its waters with a gentle intumeſcence, till all its power is deſtroyed, by wanting depth to aid the motion. But when its progreſs is checked in the midſt, by the prominence of rocks, or the abrupt elevation of the land, it daſhes with all the force of its depth againſt the obſtacle, and forms, by its repeated violence, that abruptneſs of the ſhore which confines its impetuoſity. Where the ſea is extremely deep, or very much vexed by tempeſts, it is no ſmall obſtacle that can confine its rage; and for this reaſon we ſee the boldeſt ſhores projected againſt the deepeſt waters; all leſs impediments having long before been ſurmounted and waſhed away. Perhaps of all the ſhores in the world, there is not one ſo high as that on the weſt of St. Kilda, which, upon a late admeaſurement, was found to be ſix hundred fathom perpendicular above the ſurface of the ſea. Here alſo, the ſea is deep, turbulent, and ſtormy; ſo that it requires great force in the ſhore to oppoſe its violence. In many parts of the world, and particularly upon the coaſts of the Eaſt-Indies, the ſhores, though not high above water, are generally very deep, and conſequently the waves roll againſt the land with great weight and irregularity. This riſing of the waves againſt the ſhore, is called by mariners the ſurf of the ſea; and in ſhipwrecks is generally fatal to ſuch as attempt to ſwim on ſhore. In this caſe, no dexterity in the ſwimmer, no float he can uſe, neither ſwimming girdle nor cork jacket will ſave him; the weight of the ſuperincumbent waves break upon him at once, and cruſhes him with certain ruin. Some few of the natives, however, have the art of ſwimming and of navigating their little boats near thoſe ſhores, where an European is ſure of inſtant deſtruction.

In places where the force of the ſea is leſs violent, or its tides leſs rapid, the ſhores are generally ſeen to deſcend with a more gradual declivity. Over theſe, the waters of the tide ſteal by almoſt imperceptible degrees, covering them for a large extent, and leaving them bare on its receſs. Upon theſe ſhores, as was ſaid, the ſea ſeldom beats with any great violence, as a large wave has not depth ſufficient to float it onwards; ſo that here only are to be ſeen gentle ſurges making calmly towards land, and leſſening as they approach. As the ſea, in the former deſcription, is generally ſeen to preſent proſpects of tumult and uproar, here it more uſually exhibits a ſcene of repoſe and tranquil beauty. Its waters, which when ſurveyed from the precipice, afforded a muddy greeniſh hue, ariſing from their depth and poſition to the eye, when regarded from a ſhelving ſhore, wear the colour of the ſky, and ſeem riſing to meet it. The deafening noiſe of the deep ſea, is here converted into gentle murmurs; inſtead of the water's daſhing againſt the face of the rock, it advances and recedes, ſtill going forward, but with juſt force enough to puſh its weeds and ſhells, by inſenſible approaches, to the ſhore.

There are other ſhores, beſide thoſe already deſcribed, which either have been raiſed by art to oppoſe the ſea's approaches, or from the ſea's gaining ground, are threatened with imminent deſtruction. The ſea's being thus ſeen to give and take away lands at pleaſure, is, without queſtion, one of the moſt extraordinary conſiderations in all natural hiſtory. In ſome places it is ſeen to obtain the ſuperiority by ſlow and certain approaches; or to burſt in at once, and overwhelm all things in undiſtinguiſhed deſtruction; in other places it departs from its ſhores, and where its waters have been known to rage, it leaves fields covered with the moſt beautiful verdure.

The formation of new lands, by the ſea's continually bringing its ſediment to one place, and by the accumulation of its ſands in another, is eaſily conceived. We have had many inſtances of this in England. The iſland of Oxney, which is adjacent to Romney-marſh, was produced in this manner. This had for a long time been a low level, continually in danger of being overflown by the river Rother; but the ſea, by its depoſitions, has gradually raiſed the bottom of the river, while it has hollowed the mouth; ſo that the one is ſufficiently ſecured from inundations, and the other is deep enough to admit ſhips of conſiderable burthen. The like alſo may be ſeen at that bank called the Dogger-ſands, where two tides meet, and which thus receive new increaſe every day, ſo that in time the place ſeems to promiſe fair for being habitable earth. On many parts of the coaſts of France, England, Holland, Germany, and Pruſſia, the ſea has been ſenſibly known to retire. Hubert Thomas aſſerts, in his Deſcription of the Country of Liege, that the ſea formerly encompaſſed the city of Tongres, which, however, is at preſent thirty-five leagues diſtant from it: this aſſertion he ſupports by many ſtrong reaſons; and among others, by the iron rings fixed in the walls of the town, for faſtening the ſhips that came into the port. In Italy there is a conſiderable piece of ground gained at the mouth of the river Arno; and Ravenna, that once ſtood by the ſea-ſide, is now conſiderably removed from it. But we need ſcarce mention theſe, when we find that the whole republic of Holland ſeems to be a conqueſt upon the ſea, and in a manner reſcued from its boſom. The ſurface of the earth, in this country, is below the level of the bed of the ſea; and we remember, upon approaching the coaſt, to have looked down upon it from the ſea, as into a valley; however, it is every day riſing higher by the depoſitions made upon it by the ſea, the Rhine, and the Meuſe; and thoſe parts which formerly admitted large men of war, are now known to be too ſhallow to receive ſhips of very moderate burthen. The province of Jucatan, a pininſula in the gulph of Mexico, was formerly a part of the ſea: this tract, which ſtretches out into the ocean an hundred leagues, and which is above thirty broad, is every where, at a moderate depth below the ſurface, compoſed of ſhells, which evince that its land once formed the bed of the ſea. In France, the town of Aigues Mortes was a port in the times of St. Louis, which is now removed more than four miles from the ſea. Pſalmodi, in the ſame kingdom, was an iſland in the year 815, but is now more than ſix miles from the ſhore. All along the coaſt of Norfolk, we are well aſſured, that in the memory of man, the ſea has gained fifty yards in ſome places, and has loſt as much in others.

Thus numerous, therefore, are the inſtances of new lands having been produced from the ſea, which, as we ſee, is brought about two different ways: firſt, by the waters raiſing banks of ſand and mud where their ſediment is depoſited; and ſecondly, by their relinquiſhing the ſhore entirely, and leaving it unoccupied to the induſtry of man.

But as the ſea has been thus known to recede from ſome lands, ſo has it, by fatal experience, been found to encroach upon others: and, probably, theſe depredations on one part of the ſhore, may account for their dereliction from another; for the current which reſted upon ſome certain bank, having got an egreſs in ſome other place, it no longer preſſes upon its former bed, but pours all its ſtream into the new entrance, ſo that every inundation of the ſea may be attended with ſome correſpondent dereliction of another ſhore.

However this be, we have numerous hiſtories of the ſea's inundations, and its burying whole provinces in its boſom. Many countries that have been thus deſtroyed, bear melancholy witneſs to the truth of hiſtory; and ſhew the tops of their houſes, and the ſpires of their ſteeples, ſtill ſtanding at the bottom of the water. One of the moſt conſiderable inundations we have in hiſtory, is that which happened in the reign of Henry I. which overflowed the eſtates of the Earl Godwin, and forms now that bank called the Goodwin ſands. In the year 1546, a ſimilar irruption of the ſea deſtroyed an hundred thouſand perſons in the territory of Dort; and yet a greater number round Dullart. In Friezland, and Zealand, there were more than three hundred villages overwhelmed; and their remains continue ſtill viſible at the bottom of the water in a clear day. The Baltic ſea has, by ſlow degrees, covered a large part of Pomerania; and, among others, deſtroyed and overwhelmed the famous port of Vineta. In the ſame manner, the Norwegian ſea has formed ſeveral little iſlands from the main land, and ſtill daily advances upon the continent. The German ſea has advanced upon the ſhores of Holland, near Catt; ſo that the ruins of an ancient citadel of the Romans, which was formerly built upon this coaſt, are now actually under water. To theſe accidents ſeveral more might be added; our own hiſtorians, and thoſe of other countries, abound with them; almoſt every flat ſhore of any extent, being able to ſhew ſomething that it has loſt, or ſomething that it has gained from the ſea.

There are ſome ſhores on which the ſea has made temporary depredations; where it has overflowed, and after remaining perhaps ſome ages it has again retired of its own accord, or been driven back

back by the industry of man. There are many lands in Norway, Scotland, and the Maldivia islands, that are at one time covered with water, and at another free. The country round the Isle of Ely, in the times of Bede, about a thousand years ago, was one of the most delightful spots in the whole kingdom. It was not only richly cultivated, and produced all the necessaries of life, but grapes also that afforded excellent wine. The accounts of that time are copious in the description of its verdure and fertility; its rich pastures, covered with flowers and herbage; its beautiful shades, and wholesome air. But the sea breaking in, upon the land, overwhelmed the whole country, took possession of the soil, and totally destroyed one of the most fertile vallies in the world. Its air, from being dry and healthful, from that time became most unwholesome, and clogged with vapours; and the small part of the country that, by being higher than the rest, escaped the deluge, was soon rendered uninhabitable, from its noxious vapours. Thus this country continued under water for some centuries; till, at last, the sea, by the same caprice which had prompted its invasions, began to abandon the earth in like manner. It has continued for some ages to relinquish its former conquests; and although the inhabitants can neither boast the longevity, nor the luxuries of their former pre-occupants, yet they find ample means of subsistence; and if they happen to survive the first year of their residence there, they are often known to arrive at a good old age.

But although history be silent as to many other inundations of the like kind, where the sea has overflowed the country, and afterwards retired, yet we have numberless testimonies of another nature, that prove it beyond the possibility of doubt: we mean those numerous trees that are found buried at considerable depths in places where either rivers, or the sea, has accidentally overflown. At the mouth of the river Ness, near Bruges, in Flanders, at the depth of fifty feet, are found great quantities of trees lying as close to each other as they do in a wood: the trunks, the branches, and the leaves, are in such perfect preservation, that the particular kind of each tree may instantly be known. About five hundred years ago, this very ground was known to have been covered with the sea; nor is there any history or tradition of its having been dry ground, which we can have no doubt must have been the case. Thus we see a country flourishing in verdure, producing large forests, and trees of various kinds, overwhelmed by the sea. We see this element depositing its sediment to an height of fifty feet; and its waters must, therefore, have risen much higher. We see the same, after it has thus overwhelmed, and sunk the land so deep beneath its slime, capriciously retiring from the same coasts, and leaving that habitable once more, which it had formerly destroyed. All this is wonderful; and perhaps, instead of attempting to enquire after the cause, which has hitherto been inscrutable, it will best become us to rest satisfied with admiration.

At the city of Modena in Italy, and about four miles round it, wherever it is dug, when the workmen arrive at the depth of sixty-three feet, they come to a bed of chalk, which they bore with an augre five feet deep: they then withdraw from the pit, before the augre is removed, and upon its extraction, the water bursts up through the aperture with great violence, and quickly fills this new-made well, which continues full, and is affected neither by rains or droughts. But that which is most remarkable in this operation, is the layers of earth as we descend. At the depth of fourteen feet, are found the ruins of an ancient city, paved streets, houses, floors, and different pieces of Mosaic. Under this is found a solid earth, that would induce one to think had never been removed; however, under it is found a soft oozy earth, made up of vegetables; and at twenty-six feet depth, large trees entire, such as walnut-trees, with the walnuts still sticking on the stem, and their leaves and branches in exact preservation. At twenty-eight feet deep, a soft chalk is found, mixed with a vast quantity of shells; and this bed is eleven feet thick. Under this, vegetables are found again, with leaves, and branches of trees as before; and thus alternately chalk and vegetable earth to the depth of sixty-three feet. These are the layers wherever the workmen attempt to bore; while in many of them, they also find pieces of charcoal, bones, and bits of iron. From this description, therefore, it appears, that this country has been alternately overflowed and deserted by the sea, one age after another: nor were these overflowings and retirings of trifling depth, or of short continuance. When the sea burst in, it must have been a long time in overwhelming the branches of the fallen forest with its sediments; and still longer in forming a regular bed of shells eleven feet over them. It must have, therefore, taken an age, at least, to make any one of these layers; and we may conclude, that it must have been many ages employed in the production of them all. The land, also, upon being deserted, must have had time to grow compact, to gather fresh fertility, and to be drained of its waters before it could be disposed to vegetation; nor before its trees could have shot forth again to maturity.

We have instances nearer home of the same kind, given us in the Philosophical Transactions; one of them by Mr. Derham. An inundation of the sea, at Dagenham, in Essex, laying bare a part of the adjacent pasture, for above two hundred feet wide, and, in some places, twenty deep, it discovered a number of trees that had lain there for many ages before; these trees, by lying long under ground, were become black and hard, and their fibres so tough, that one might as easily break a wire, as any of them: they lay so thick in the place where they were found, that in many parts he could step from one to another: he conceived also, that not only all the adjacent marshes, for several hundred acres, were covered underneath with such timber, but also the marshes along the mouth of the Thames, for several miles. The meeting with these trees at such depths, he ascribes to the sediment of the river, and the tides, which constantly washing over them, have always left some part of their substance behind, so as, by repeated alluvions, to work a bed of vegetable earth over them, to the height at which he found it.

The levels of Hatfield-Chace, in Yorkshire, a tract of above eighteen thousand acres, which was yearly overflown, was reduced to arable and pasture land, by one Sir Cornelius Vermusden, a Dutchman. At the bottom of this wide extent, are found millions of the roots and bodies of trees, of such as this island either formerly did, or does at present produce. The roots of all stand in their proper postures; and by them, as thick as ever they could grow, the respective trunks of each, some above thirty yards long. The oaks, some of which have been sold for fifteen pounds a piece, are as black as ebony, very lasting, and close grained. The ash-trees are as soft as earth, and are commonly cut in pieces by the workmen's spades, and as soon as flung up into the open air, turn to dust. But all the rest, even the willows themselves, which are softer than the ash, preserve their substance and texture to this very day. Some of the firs appear to have vegetated, even after they were fallen, and to have, from their branches, struck up large trees, as great as the parent trunk. It is observable, that

many of these trees have been burnt, some quite through, some on one side, some have been found chopped and squared, others riven with great wooden wedges; all sufficiently manifesting, that the country which was deluged, had formerly been inhabited. Near a great root of one tree, were found eight coins of the Roman emperors; and, in some places, the marks of the ridge and furrow were plainly perceivable, which testified that the ground had formerly been patient of cultivation.

The learned naturalist who has given this description, has pretty plainly evinced, that this forest, in particular, must have been thus levelled by the Romans; and that the falling of the trees, must have contributed to the accumulation of the waters. "The Romans," says he, "when the Britons fled, always pursued them into the fortresses of low woods, and miry forests: in these the wild natives found shelter; and, when opportunity offered, issued out, and fell upon their invaders without mercy. In this manner, the Romans were at length so harrassed, that orders were issued out for cutting down all the woods and forests in Britain. In order to effect this, and destroy the enemy the easier, they set fire to the woods, composed of pines, and other inflammable timber, which spreading, the conflagration destroyed not only the forest, but infinite numbers of the wretched inhabitants who had taken shelter therein. When the pine-trees had thus done what mischief they could, the Romans then brought their army nearer, and, with whole legions of the captive Britons, cut down most of the trees that were yet left standing; leaving only here and there some great trees untouched, as monuments of their fury. These, unneedful of their labour, being destitute of the support of the underwood, and of their neighbouring trees, were easily overthrown by the winds, and, without interruption, remained on the places where they happened to fall. The forest, thus fallen, must necessarily have stopped up the currents, both from land and sea; and turned into great lakes, what were before but temporary streams. The working of the waters here, the consumption and decay of rotten boughs and branches, and the vast increase of water-moss which flourishes upon marshy grounds, soon formed a covering over the trunks of the fallen trees, and raised the earth several feet above its former level. The earth thus every day swelling, by a continual increase from the sediment of the waters, and by the lightness of the vegetable substances of which it was composed, soon overtopt the waters by which this intumescence was at first effected; so that it entirely got rid of its inundations, or only demanded a slight assistance from man for that purpose." This may be the origin of all bogs, which are formed by the putrefaction of vegetable substances, mixed with the mud and slime deposited by waters, and at length acquiring a sufficient consistency.

From this we see what powerful effects the sea is capable of producing upon its shores, either by overflowing some, or deserting others; by altering the direction of these, and rendering those craggy and precipitate, which before were shelving. But the influence it has upon these, is nothing to that which it has upon that great body of earth which forms its bottom. It is at the bottom of the sea that the greatest wonders are performed, and the most rapid changes are produced; it is there that the motion of the tides and the currents have their whole force, and agitate the substances of which their bed is composed. But all these are almost wholly hid from human curiosity: the miracles of the deep are performed in secret; and we have but little information from its abysses, except what we receive by inspection at very shallow depths, or by the plummet, or from divers, who are known to descend from twenty to thirty fathom.

The eye can reach but a very short way into the depths of the sea; and that only when its surface is glassy and serene. In many seas it perceives nothing but a bright sandy plain at bottom, extending for several hundred miles, without an intervening object. But in others, particularly in the Red Sea, it is very different: the whole bottom of this extensive bed of waters is, literally speaking, a forest of submarine plants, and corals formed by insects for their habitation, sometimes branching out to a great extent. Here are seen the madrepores, the sponges, mosses, sea-mushrooms, and other marine productions, covering every part of the bottom; so that some have even supposed the sea to have taken its name from the colour of its plants below. However, these plants are by no means peculiar to this sea, as they are found in great quantities in the Persian gulph, along the coasts of Africa, and those of Provence and Catalonia.

The bottom of many parts of the sea near America presents a very different, though a very beautiful appearance. This is covered with vegetables, which make it look as green as a meadow, and beneath are seen thousands of turtles, and other sea-animals, feeding thereon.

In order to extend our knowledge of the sea to greater depths, recourse has been had to the plummet; which is generally made of a lump of lead of about forty pounds weight, fastened to a cord. This, however, only answers in moderate depths; for when a deep sea is to be sounded, the matter of which the cord is composed being lighter than the water, floats upon it, and when let down to a considerable depth, its length so increases its surface, that it is often sufficient to prevent the lead from sinking; so that this may be the reason that some parts of the sea are said to have no bottom.

In general, we learn from the plummet, that the bottom of the sea is tolerably even where it has been examined; and that the farther from the shore, the sea is in general the deeper. Notwithstanding in the midst of a great and unfathomable ocean, we often find an island raising its head, and singly braving its fury. Such islands may be considered as the mountains of the deep; and, could we for a moment imagine the waters of the ocean removed, or dried away, we should probably find the inequalities of its bed resembling those that are found at land. Here extensive plains; there valleys; and, in many places, mountains of amazing height. M. Buache has actually given us a map of that part of its bottom, which lies between Africa and America, taken from the several soundings of mariners: in it we find the same uneven surface that we do upon land, the same eminences, and the same depressions. In such an imaginary prospect, however, there would be this difference, that, at the tops of land-mountains appear the most barren and rocky, the tops of sea-mountains would be found the most verdant and fruitful.

The plummet, which thus gives us some idea of the inequalities of the bottom, leaves us totally in the dark as to every other particular; recourse, therefore, has been had to divers: these, either being bred up in this dangerous way of life, and accustomed to remain some time under water without breathing, or assisted by means of a diving-bell, have been able to return some confused and uncertain accounts of the places below. In the great diving-bell improved by Doctor Halley, which was large enough to contain five men, and was supplied by fresh air by buckets, that alternately rose and fell, they descended fifty fathom. In this huge machine, which was let down from the mast of the ship, the doctor himself went down to the

the bottom, where, when the ſea was clear, and eſpecially when the ſun ſhone, he could ſee perfectly well to write or read, and much more to take up any thing that was underneath: at other times, when the water was troubled and thick, it was as dark as night below, ſo that he was obliged to keep a candle lighted at the bottom. But there is one thing very remarkable: that the water which from above was uſually ſeen of a green colour, when looked at from below, appeared to him of a very different one, caſting a redneſs upon one of his hands, like that of damaſk roſes: a proof of the ſea's taking its colour not from any thing floating in it, but from the different reflections of the rays of light. Upon the whole, the accounts we have received from the bottom, by this contrivance, are but few. We learn from it, and from divers in general, that while the ſurface of the ſea may be deformed by tempeſts, it is uſually calm and temperate below; that ſome divers who have gone down when the weather was calm, and came up when it was tempeſtuous, were ſurpriſed at their not perceiving the change at the bottom. This, however, muſt not be ſuppoſed to obtain with regard to the tides, and the currents, as they are ſeen conſtantly ſhifting their bottom; taking their bed with great violence from one place, and depoſiting it upon another. We are informed, alſo, by divers, that the ſea grows colder in proportion as they deſcend to the bottom; that as far as the ſun's rays pierce, it is influenced by their warmth; but lower, the cold becomes almoſt intolerable. A perſon of quality, who had been himſelf a diver, as Mr. Boyle informs us, declared, that though he ſeldom deſcended above three or four fathoms, yet he found it ſo much colder than near the top, that he could not well endure it; and that being let down in a great diving-bell, although the water could not immediately touch him, he found the air extremely cold upon his firſt arrival at the bottom.

From divers alſo we learn, that the ſea in many places is filled with rocks at bottom: and that among their clifts, and upon their ſides, various ſubſtances ſprout forward, which are either really vegetables, or the neſts of inſects, increaſed to ſome magnitude. Some of theſe aſſume the ſhape of beautiful flowers; and, though ſoft, when taken up, ſoon harden, and are kept in the cabinets of the curious.

But, of all thoſe divers who have brought us information from the bottom of the deep, the famous Nicola Peſçe, whoſe performances are told us by Kircher, is the moſt celebrated. We will not pretend to vouch for the veracity of Kircher's account, which he aſſures us he had from the archives of the kings of Sicily; but it may ſerve to enliven an heavy chapter. "In the times of Frederic, king of Sicily, there lived a celebrated diver, whoſe name was Nicolas, and who from his amazing ſkill in ſwimming, and his perſeverance under water, was ſurnamed the fiſh. This man had, from his infancy, been uſed to the ſea; and earned his ſcanty ſubſiſtence by diving for corals and oyſters, which he ſold to the villagers on ſhore. His long acquaintance with the ſea, at laſt, brought it to be almoſt his natural element. He frequently was known to ſpend five days in the midſt of the waves, without any other proviſions than the fiſh which he caught there, and ate raw. He often ſwam over from Sicily to Calabria, a tempeſtuous and dangerous paſſage, carrying letters from the king. He was frequently known to ſwim among the gulphs of the Lipari iſlands, no way apprehenſive of danger.

"Some mariners out at ſea one day obſerved ſomething at ſome diſtance from them, which they regarded as a ſea-monſter; but upon its approach, it was known to be Nicolas, whom they took into their ſhip. When they aſked him whither he was going in ſo ſtormy and rough a ſea, and at ſuch a diſtance from land, he ſhewed them a packet of letters, which he was carrying to one of the towns of Italy, exactly done up in a leather bag, in ſuch a manner as that they could not be wetted by the ſea. He kept them thus company for ſome time on their voyage, converſing and aſking queſtions; and after eating an hearty meal with them, he took his leave, and jumping into the ſea, purſued his voyage alone.

"In order to aid theſe powers of enduring in the deep, nature ſeemed to have aſſiſted him in a very extraordinary manner; for the ſpaces between his fingers and toes were webbed, as in a gooſe; and his cheſt became ſo very capacious, that he could take in at one inſpiration, as much breath as would ſerve him for a whole day.

"The account of ſo extraordinary a perſon did not fail to reach the king himſelf; who actuated by the general curioſity, ordered that Nicolas ſhould be brought before him. It was no eaſy matter to find Nicolas, who generally ſpent his time in the ſolitudes of the deep; but at laſt, however, after much ſearching, he was found, and brought before his majeſty. The curioſity of this monarch had been long excited by the accounts he had heard of the bottom of the gulph of Charybdis; he therefore conceived that it would be a proper opportunity to have more certain information; and commanded our poor diver to examine the bottom of this dreadful whirlpool: as an incitement to his obedience, he ordered a golden cup to be flung into it. Nicolas was not inſenſible of the danger to which he was expoſed; dangers beſt known only to himſelf; and he therefore preſumed to remonſtrate; but the hopes of the reward, the deſire of pleaſing the king, and the pleaſure of ſhewing his ſkill, at laſt prevailed. He inſtantly jumped into the gulph, and was ſwallowed as inſtantly up in its boſom. He continued for three quarters of an hour below; during which time the king and his attendants remained upon ſhore anxious for his fate; but he at laſt appeared, buffeting upon the ſurface, holding the cup in triumph in one hand, and making his way good among the waves with the other. It may be ſuppoſed he was received with applauſe, upon his arrival on ſhore; the cup was made the reward of his adventure; the king ordered him to be taken proper care of; and, as he was ſomewhat fatigued and debilitated by his labour, after an hearty meal, he was put to bed, and permitted to refreſh himſelf by ſleeping.

"When his ſpirits were thus reſtored, he was again brought to ſatisfy the king's curioſity with a narrative of the wonders he had ſeen; and his account was to the following effect. He would never, he ſaid, have obeyed the king's commands, had he been apprized of half the dangers that were before him. There were four things, he ſaid, that rendered the gulph dreadful, not only to men, but even to the fiſhes themſelves: firſt, the force of the water burſting up from the bottom, which requires great ſtrength to reſiſt; ſecondly, the abruptneſs of the rocks, that on every ſide threaten deſtruction; thirdly, the force of the whirlpool, daſhing againſt thoſe rocks; and fourthly, the number and magnitude of the polypus fiſh, ſome of which appeared as large as a man, and which every where ſticking againſt the rocks, projected their fibrous arms to entangle him. Being aſked how he was able ſo readily to find the cup that had been thrown in, he replied, that it happened to be flung by the waves into the cavity of a rock, againſt which he himſelf was urged in his deſcent. This account, however, did not ſatisfy the king's curioſity; being requeſted

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to venture once more into the gulph for further discoveries, he at first refused; but the king, desirous of having the most exact information possible of all things to be found in the gulph, repeated his solicitations; and, to give them still greater weight, produced a larger cup than the former, and added also a purse of gold. Upon these considerations, the unfortunate Pessacola once again plunged into the whirlpool, and was never heard of more.

CHAP. XVIII.

A particular Account of the Mechanical Properties of AIR.

HAVING described the earth and the sea, we now ascend into that fluid which surrounds them both; and which, in some measure, supports and supplies all animated nature. As upon viewing the bottom of the ocean from its surface, we see an infinity of animals moving therein, and seeking food; so were some superior being to regard the earth at a proper distance, he might consider us in the same light: he might, from his superior station, behold a number of busy little beings, immersed in the aerial fluid, that every where surrounds them, and sedulously employed in procuring the means of subsistence. This fluid, though too fine for the gross perception of its inhabitants, might, to his nicer organs of sight, be very visible; and, while he at once saw into its operations, he might smile at the varieties of human conjecture concerning it: he might readily discern, perhaps, the height above the surface of the earth to which this fluid atmosphere reaches: he might exactly determine that peculiar form of its parts which gives it the spring or elasticity with which it is endued: he might distinguish which of its parts were pure incorruptible air, and which only made for a little time to assume the appearance, so as to be quickly returned back to the element from whence it came. But as for us, who are immersed at the bottom of this gulph, we must be contented with a more confined knowledge; and, wanting a proper point of prospect, remain satisfied with a combination of the effects.

One of the first things that our senses inform us of is, that although the air is too fine for our sight, it is very obvious to our touch. Although we cannot see the wind contained in a bladder, we can very readily feel its resistance; and though the hurricane may want colour, we often fatally experience that it does not want force. We have equal experience of the air's spring or elasticity; the bladder, when pressed, returns again, upon the pressure being taken away; a bottle, when filled, often bursts, from the spring of air which is included.

So far the slightest experience reaches; but, by carrying experiment a little farther, we learn, that air also is heavy: a round glass vessel being emptied of its air, and accurately weighed, has been found lighter than when it was weighed with the air in it. Upon computing the superior weight of the full vessel, a cubic foot of air is found to weigh something more than an ounce.

From this experiment, therefore, we learn, that the earth, and all things upon its surface, are every where covered with a ponderous fluid, which rising very high over our heads, must be proportionably heavy. For instance, as in the sea, a man at the depth of twenty feet, sustains a greater weight of water than a man at the depth of but ten feet; so will a man at the bottom of a valley have a greater weight of air over him, than a man on the top of a mountain.

From hence we may conclude, that we sustain a very great weight of air; and although, like men walking at the bottom of the sea, we cannot feel the weight which presses equally round us, yet the pressure is not the less real. As in morals, we seldom know the blessings that surround us till we are deprived of them, so here we do not perceive the weight of the ambient fluid till a part of it is taken away. If, by any means, we contrive to take away the pressure of the air from any one part of our bodies, we are soon made sensible of the weight upon the other parts. If we clap our hand upon the mouth of a vessel from whence the air has been taken away, there will thus be air on one side, and none on the other; upon which, we shall instantly find the hand violently sucked inwards, which is nothing more than the weight of the air upon the back of the hand that forces it into the space which is empty below.

As by this experiment we perceive that the air presses with great weight upon every thing on the surface of the earth, so by other experiments we learn the exact weight with which it presses. First, if the air be exhausted out of any vessel, a drinking-vessel for instance, and this vessel be set with the mouth downwards in water, the water will rise up into the empty space, and fill the inverted glass; for the external air will, in this case, press up the water, where there is no weight to resist; as, one part of a bed being pressed, makes the other parts, that have no weight upon them, rise. In this case, as was said, the water being pressed without, will rise in the glass; and would continue to rise (if the empty glass were tall enough) thirty-two feet high. In fact, there have been pipes made purposely for this experiment of above thirty-two feet high; in which, upon being exhausted, the water has always risen to the height of thirty-two feet: there it has always rested, and never ascended higher. From this, therefore, we learn, that the weight of the air which presses up the water, is equal to a pillar or column of water, which is thirty-two feet high; as it is just able to raise such a column, and no more. In other words, the surface of the earth is every where covered with a weight of air, which is equivalent to a covering of thirty-two feet deep of water; or to a weight of twenty-nine inches and an half of quicksilver, which is known to be just as heavy as the former.

Thus we see that the air at the surface of the earth is just as heavy as thirty-two feet of water, or twenty-nine inches and an half of quicksilver; and it is easily found, by computation, that to raise water thirty-two feet, will require a weight of fifteen pounds upon every square inch. Now, if we are fond of computations, we have only to calculate how many square inches are in the surface of an ordinary human body, and allowing every inch to sustain fifteen pounds, we may amaze ourselves at the weight of air we sustain. It has been computed, and found, that our ordinary load of air amounts to within a little of forty thousand pounds: this is wonderful! but wondering is not the way to grow wise.

Notwithstanding this be our ordinary load, and our usual supply, there are at different times very great variations. The air is not, like water, equally heavy at all seasons; but sometimes is lighter, and sometimes more heavy. It is sometimes more compress, and sometimes more elastic or springy, which produces the same effects as an increase of its weight. The air which at one time raises water thirty-two feet in the tube, and quick-

ſilver twenty-nine inches, will not at another raiſe the one to thirty feet, or the other to twenty-ſix inches. This makes, therefore, a very great difference in the weight we ſuſtain; and we are actually known, by computation, to carry at one time four thouſand pounds of air more than at another.

The reaſon of this ſurpriſing difference in the weight of air, is either owing to its preſſure from above, or to an increaſe of vapour floating in it. Its increaſed preſſure is the conſequence of its ſpring or elaſticity, which cold and heat ſenſibly affect, and are continually changing.

This elaſticity of the air is one of its moſt amazing properties; and to which it ſhould ſeem nothing can ſet bounds. A body of air that may be contained in a nut-ſhell, may eaſily, with heat, be dilated into a ſphere of unknown dimenſions. On the contrary, the air contained in an houſe, may be compreſſed into a cavity not larger than the eye of a needle. In ſhort, no bounds can be ſet to its confinement or expanſion; at leaſt, experiment has hitherto found its attempts indefinite. In every ſituation, it retains its elaſticity; and the more cloſely we compreſs it, the more ſtrongly does it reſiſt the preſſure. If to the increaſing the elaſticity on one ſide by compreſſion, we increaſe it on the other ſide by heat, the force of both ſoon becomes irreſiſtible; and a certain French philoſopher ſuppoſed, that air thus confined, and expanding, was ſufficient for the exploſion of a world.

Many inſtruments have been formed to meaſure and determine theſe different properties of the air; and which ſerve ſeveral uſeful purpoſes. The barometer ſerves to meaſure its weight; to tell us when it is heavier, and when lighter. It is compoſed of a glaſs tube or pipe, of about thirty inches in length, cloſed up at one end; this tube is then filled with quickſilver; this done, the maker clapping his finger upon the open end, inverts the tube, and plunges the open end, finger and all, into a baſon of quickſilver, and then takes his finger away: now the quickſilver in the tube will, by it own weight, endeavour to deſcend into that in the baſon; but the external air, preſſing on the ſurface of the quickſilver in the baſon without, and no air being in the tube at top, the quickſilver will continue in the tube, being preſſed up, as was ſaid, by the air, on the ſurface of the baſon below. The height at which it is known to ſtand in the tube, is uſually about twenty-nine inches, when the air is heavy; but not above twenty-ſix, when the air is very light. Thus, by this inſtrument we can, with ome exactneſs, determine the weight of the air; and, of conſequence, tell before-hand the changes of the weather. Before the fine dry weather, the air is charged with a variety of vapours, which float in it unſeen, and render it extremely heavy, ſo that it preſſes up the quickſilver; or, in other words, the barometer riſes. In moiſt, rainy weather, the vapours are waſhed down, or there is not heat ſufficient for them to riſe, ſo that the air is then ſenſibly lighter, and preſſes up the quickſilver with leſs force; or, in other words, the barometer is ſeen to fall. Our conſtitutions ſeem alſo to correſpond with the changes of the weather-glaſs; they are braced, ſtrong, and vigorous, with a large body of air upon them; they are languid, relaxed, and feeble, when the air is light, and refuſes to give our fibres their proper tone.

But although the barometer thus meaſures the weight of the air with exactneſs enough for the general purpoſes of life, yet it is often affected with a thouſand irregularities, that no exactneſs in the inſtrument can remedy, nor no theory account for. When high winds blow, the quickſilver generally is low; it riſes higher in cold weather than in warm; and is uſually higher at morning and evening than at mid-day: it generally deſcends lower after rain than it was before it. There are alſo frequent changes in the air, without any ſenſible alteration in the barometer.

As the barometer is thus uſed in predicting the changes of the weather, ſo it is alſo ſerviceable in meaſuring the heights of mountains, which mathematicians cannot ſo readily do: for, as the higher we aſcend from the ſurface of the earth, the air becomes lighter, ſo the quickſilver in the barometer will deſcend in proportion. It is found to ſink at the rate of the tenth part of an inch for every ninety feet we aſcend; ſo that in going up a mountain, if we find the quickſilver fallen an inch, we conclude, that we are got upon an aſcent of near nine hundred feet high. In this there has been found ſome variation; into a detail of which, it is not the buſineſs of a natural hiſtorian to enter.

In order to determine the elaſticity of air, the wind-gun has been invented, which is an inſtrument variouſly made; but in all upon the principle of compreſſing a large quantity of air into a tube, in which there is an ivory ball, and then giving the compreſſed elaſtic air free power to act, and drive the ball as directed. The ball thus driven will pierce a thick board: and will be as fatal, at ſmall diſtances, as if driven with gunpowder. Perhaps the force of this inſtrument has never been aſſiſted by means of heat; this, which could be very eaſily contrived by means of phoſphorus, or any other hot ſubſtance applied to the barrel, would produce a greater force than gunpowder itſelf.

The air pump is an inſtrument contrived to exhauſt the air from round a veſſel adapted to that purpoſe, called a receiver. This method of exhauſting, is contrived in the ſimple inſtrument, by a piſton, like that of a ſyringe, going down into the veſſel, and thus puſhing out its air; which, by means of a valve, is prevented from returning into the veſſel again.

But this, like all other complicated inſtruments, will be better underſtood by a minute inſpection, than an hour's deſcription: it may ſuffice here to obſerve, that by depriving animals, and other ſubſtances, of all air, it ſhews us what the benefits and effects of air are in ſuſtaining life, or promoting vegetation.

The digeſter is an inſtrument of ſtill more extraordinary effects than any of the former; and ſufficiently diſcovers the amazing force of air, when its elaſticity is augmented by fire. A common tea-kettle, if the ſpout were cloſed up, and the lid put firmly down, would ſerve to become a digeſter, if ſtrong enough. But the inſtrument uſed for this purpoſe, is a ſtrong metal pot, with a lid to ſcrew cloſe on, ſo that, when down, no air can get in or return: into this pot meat and bones are put, with a ſmall quantity of water, and then the lid ſcrewed cloſe: a lighted lamp is put underneath, and, what is very extraordinary (yet equally true), in ſix or eight minutes the whole maſs, bones and all, are diſſolved into a jelly; ſo great is the force and elaſticity of the air contained within, ſtruggling to eſcape, and breaking in pieces all the ſubſtances with which it is mixed. Care, however, muſt be taken not to heat this inſtrument too violently; for then, the incloſed air would become irreſiſtible, and burſt the whole, with perhaps a fatal exploſion.

There are numberleſs other uſeful inſtruments made to depend on the weight, the elaſticity, or the fluidity of the air, which do not come within the plan of the preſent work; the deſign of which is not to give an account of the inventions that have been made for determining the nature and properties of air, but a mere narrative of its effects. The deſcription of the pump, the forcing-pump, the fire-engine, the ſteam-engine, the ſyphon, and many

many others, belong not to the naturaliſt, but the experimental philoſopher: the one gives an hiſtory of Nature, as he finds ſhe preſents herſelf to him; and he draws the obvious picture: the other purſues her with cloſe inveſtigation, tortures her by experiment to give up her ſecrets, and meaſures her latent qualities with laborious preciſion. Much more therefore, might be ſaid of the mechanical effects of air, and of the conjectures that have been made reſpecting the form of its parts; how ſome have ſuppoſed them to reſemble little hoops, coiled up in a ſpring; others, like fleeces of wool; others, that the parts are endued with a repulſive quality, by which, when ſqueezed together, they endeavour to fly off, and recede from each other. We might have given the diſputes relative to the height to which this body of air extends above us, and concerning which there is no agreement. We might have enquired how much of the air we breathe is elementary, and not reducible to any other ſubſtance; and of what denſity it would become, if it were ſuppoſed to be continued down to the center of the earth. At that place we might, with the help of figures, and a bold imagination, have ſhewn it twenty thouſand times heavier than its bulk of gold. We might alſo prove it millions of times purer than upon earth, when raiſed to the ſurface of the atmoſphere. But theſe ſpeculations do not belong to natural hiſtory; and they have hitherto produced no great advantages in that branch of ſcience to which they more properly appertain.

CHAP. XIX.

Natural History of the AIR.

OUR atmoſphere has been conſidered by a late eminent philoſopher, as one large chemical veſſel, in which a great number of various operations are conſtantly performing. In it all the bodies of the earth are continually ſending up a part of their ſubſtance by evaporation, to mix in this great alembic, and to float a-while in common. Here minerals, from their loweſt depths, aſcend in noxious, or in warm vapours, to make a part of the general maſs; ſeas, rivers, and ſubterraneous ſprings, furniſh their copious ſupplies; plants receive and return their ſhare; and animals, that by living upon, conſume this general ſtore, are found to give it back in greater quantities, when they die. The air, therefore, that we breathe, and upon which we ſubſiſt, bears very little reſemblance to that pure elementary body which was deſcribed in the laſt chapter; and which is rather a ſubſtance that may be conceived, than experienced to exiſt. Air, ſuch as we find it, is one of the moſt compounded bodies in all nature. Water may be reduced to a fluid every way reſembling air, by heat; which, by cold, becomes water again. Every thing we ſee gives off its parts to the air, and has a little floating atmoſphere of its own round it. The roſe is encompaſſed with a ſphere of its own odorous particles; while the night-ſhade infects the air with ſcents of a more ungrateful nature. The perfume of muſk flies off in ſuch abundance, that the quantity remaining becomes ſenſibly lighter by the loſs. A thouſand ſubſtances that eſcape all our ſenſes, we know to be there; the powerful emanations of the load-ſtone, the effluvia of electricity, the rays of light, and the inſinuations of fire. Such are the various ſubſtances through which we move, and which we are conſtantly taking in at every pore, and returning again with imperceptible diſcharge!

This great ſolution, or mixture of all earthly bodies, is continually operating upon itſelf; which, perhaps, may be the cauſe of its unceaſing motion: but it operates ſtill more viſibly upon ſuch groſſer ſubſtances as are expoſed to its influence; for ſcarce any ſubſtance is found capable of reſiſting the corroding qualities of the air. The air, ſay the chemiſts, is a chaos, furniſhed with all kinds of ſalts and menſtruums; and, therefore, it is capable of diſſolving all kinds of bodies. It is well known, that copper and iron are quickly covered, and eaten with ruſt; and that in the climates near the equator, no art can keep them clean. In thoſe dreary countries, the inſtruments, knives and keys, that are kept in the pocket, are nevertheleſs, quickly encruſted; and the great guns, with every precaution, after ſome years, become uſeleſs. Stones, as being leſs hard, may be readily ſuppoſed to be more eaſily ſoluble. The marble of which the noble monuments of Italian antiquity are compoſed, although in one of the fineſt climates in the world, ſhew the impreſſions which have been made upon them by the air. In many places they ſeem worm eaten by time; and, in others, they appear crumbling into duſt. Gold alone ſeems to be exempted from this general ſtate of diſſolution; it is never found to contract ruſt, though expoſed never ſo long: the reaſon of this ſeems to be, that ſea-ſalt, which is the only menſtruum capable of acting upon, and diſſolving gold, is but very little mixed with the air; for ſalt being a very fixed body, and not apt to volatilize, and riſe with heat, there is but a ſmall proportion of it in the atmoſphere. In the elaboratories, and ſhops, however, where ſalt is much uſed, and the air is impregnated with it, gold is found to ruſt as well as other metals.

Bodies of a ſofter nature are obviouſly deſtroyed by the air. Mr. Boyle ſays, that ſilks brought to Jamaica, will, if there expoſed to the air, rot even while they preſerve their colour; but if kept therefrom, they both retain their ſtrength and gloſs. The ſame happens in Braſil, where their cloaths, which are black, ſoon turn of an iron colour; though, in the ſhops, they preſerve their proper hue. In theſe tropical climates alſo, ſuch are the putreſcent qualities of the air, that white ſugar will ſometimes be full of maggots. Drugs and plaſters loſe their virtue, and become verminous. In ſome places they are obliged to expoſe their ſweetmeats by day in the ſun, otherwiſe the night air would quickly cauſe them to putrify. On the contrary, in the cold arctic regions, animal ſubſtances, during their winter, are never known to putrify; and meat may be kept for months, without any ſalt whatſoever. This experiment happily ſucceeded with the eight Engliſhmen that were accidentally left upon the inhoſpitable coaſts of Greenland, at a place where ſeven Dutchmen had periſhed but a few years before; for killing ſome rein-deer for their ſubſiſtence, and having no ſalt to preſerve the fleſh, to their great ſurprize, they ſoon found it did not want any, as it remained ſweet during their eight months continuance upon that ſhore.

Theſe powers with which air is endued over unorganized ſubſtances, are exerted in a ſtill ſtronger manner over plants, animals of an inferior nature, and, laſtly, over man himſelf. Moſt of the beauty, and the luxuriance of vegetation, is well known to be derived from the benign influence of the air: and every plant ſeems to have its favourite climate, not leſs than its proper ſoil. The lower ranks of animals alſo, ſeem formed for their reſpective climates, in which only they can live. Man alone ſeems the child of every climate, and capable of exiſting in all. However, this peculiar privilege does not exempt him from the influences of the air; he is as much ſubject to its malignity, as the meaneſt inſect or vegetable.

With regard to plants, air is ſo abſolutely neceſſary for their life and preſervation, that they will not vegetate

vegetate in an exhauſted receiver. All plants have within them a quantity of air, which ſupports and agitates their juices. They are continually imbibing freſh nutriment from the air, to increaſe this ſtore, and to ſupply the wants which they ſuſtain from evaporation. When, therefore, the external air is drawn from them, they are no longer able to ſubſiſt. Even that quantity of air which they before were poſſeſſed of, eſcapes through their pores, into the exhauſted receiver; and as this continues to be pumped away, they become languid, grow flaccid, and die. However, the plant or flower thus ceaſing to vegetate, is kept, by being ſecured from the external air, a much longer time ſweet than it would have continued, had it been openly expoſed.

That air which is ſo neceſſary to the life of vegetables, is ſtill more ſo to that of animals; there are none found, how ſeemingly torpid ſoever, that do not require their needful ſupply. Fiſhes themſelves will not live in water from whence the air is exhauſted; and it is generally ſuppoſed that they die in frozen ponds, from the want of this neceſſary to animal exiſtence. Many have been the animals that idle curioſity has tortured in the priſon of a receiver, merely to obſerve the manner of their dying. We ſhall, from a thouſand inſtances, produce that of the viper, as it is known to be one of the moſt vivacious reptiles in the world; and as we ſhall feel but little compaſſion for its tortures. Mr. Boyle took a new-caught viper, and ſhutting it up into a ſmall receiver, began to pump away the air. At firſt, upon the air's being drawn away, it began to ſwell; ſome time after he had done pumping, it began to gape, and open its jaws; being thus compelled to open its jaws, it once more reſumed its former lankneſs; it then began to move up and down within, as if to ſeek for air, and after a while foamed a little, leaving the foam ſticking to the inſide of the glaſs; ſoon after the body and neck grew prodigiouſly tumid, and a bliſter appeared upon its back; an hour and an half after the receiver was exhauſted, the diſtended viper moved, and gave manifeſt ſigns of life; the jaws remained quite diſtended; as it were from beneath the epiglottis, came the black tongue, and reached beyond it; but the animal ſeemed, by its poſture, not to have any life; the mouth alſo was grown blackiſh within; and in this ſituation it continued for twenty-three hours. But upon the air's being re-admitted, the viper's mouth was preſently cloſed, and ſoon after opened again; and for ſome time thoſe motions continued, which argued the remains of life. Such is the fate of the moſt inſignificant or minute reptile that can be thus included. Mites, fleas, and even the little eels that are found ſwimming in vinegar, die for want of air. Not only theſe, but the eggs of theſe animals, will not produce in vacuo, but require air to bring them to perfection.

As in this manner air is neceſſary to their ſubſiſtence, ſo alſo it muſt be of a proper kind, and not impregnated with foreign mixtures. That factitious air which is pumped from plants or fluids, is generally, in a ſhort time, fatal to them. Mr. Boyle has given us many experiments to this purpoſe. After having ſhewn that all vegetable, and moſt mineral ſubſtances, properly prepared, may afford air, by being placed in an exhauſted receiver, and this in ſuch quantities, that ſome have thought it a new ſubſtance, made by the alteration which the mineral or plant has undergone by the texture of its parts being looſened in the operation—having ſhewn, that this air may be drawn in great quantities from vegetable, animal, or mineral ſubſtances, ſuch as apples, cherries, amber burnt, or hartſhorn—he included a frog in artificial air, produced from paſte; in ſeven minutes ſpace it ſuffered convulſions, and at laſt lay ſtill, and being taken out, recovered no motion at all, but was dead. A bird encloſed in artificial air, from raiſins, died in a quarter of a minute, and never ſtirred more. A ſnail was put into the receiver, with air of paſte; in four minutes it ceaſed to move, and was dead, although it had ſurvived in vacuo for ſeveral hours: ſo that factitious air proved a greater enemy to animals than even a vacuum itſelf.

Air alſo may be impregnated with fumes that are inſtantly fatal to animals. The fumes of hot iron, copper, or any other heated metal, blown into the place where an animal is confined, inſtantly deſtroy it. We have already mentioned the vapours in the grotto Del Cane ſuffocating a dog. The ancients even ſuppoſed, that theſe animals, as they always ran with their noſes to the ground, were the firſt that felt any infection. In ſhort, it ſhould ſeem that the predominance of any one vapour, from any body, how wholſome ſoever in itſelf, becomes infectious; and that we owe the ſalubrity of the air to the variety of its mixture.

But there is no animal whoſe frame is more ſenſibly affected by the changes of the air than man. It is true, he can endure a greater variety of climates than the lower orders generally are able to do; but it is rather by the means which he has diſcovered of obviating their effects, than by the apparent ſtrength of his conſtitution. Moſt other animals can bear cold or hunger better, endure greater fatigues in proportion, and are ſatisfied with ſhorter repoſe. The variations of the climate, therefore, would probably affect them leſs, if they had the ſame means or ſkill in providing againſt the ſeverities of the change. However this be, the body of man is an inſtrument much more nicely ſenſible of the variations of the air, than any of thoſe which his own art has produced; for his frame alone ſeems to unite all their properties, being invigorated by the weight of the air, relaxed by its moiſture, enfeebled by its heat, and ſtiffened by its frigidity.

But it is chiefly by the predominance of ſome peculiar vapour, that the air becomes unfit for human ſupport. It is often found by dreadful experience, to enter into the conſtitution, to mix with its juices, and to putrify the whole maſs of blood. The nervous ſyſtem is not leſs affected by its operations; palſies and vertigoes are cauſed by its damps; and a ſtill more fatal train of diſtempers by its exhalations. In order that the air ſhould be wholeſome, it is neceſſary, as we have ſeen, that it ſhould not be of one kind, but the compound of ſeveral ſubſtances; and the more various the compoſition, to all appearance the more ſalubrious. A man, therefore, who continues in one place, is not ſo likely to enjoy this wholeſome variety, as he who changes his ſituation; and, if we may ſo expreſs it, inſtead of waiting for a renovation of air, walks forward to meet his arrival. This mere motion, independent even of the benefits of exerciſe, becomes wholeſome, by thus ſupplying a great variety of that healthful fluid by which we are ſuſtained.

A thouſand accidents are found to increaſe theſe bodies of vapour, that make one place more or leſs wholſome than another. Heat may raiſe them in too great quantities; and cold may ſtagnate them. Minerals may give off their effluvia in ſuch proportion as to keep away all other kind of air; vegetables may render the air unwholeſome by their ſupply; and animal putrefaction ſeems to furniſh a quantity of vapour, at leaſt as noxious as any of the former. All theſe united, generally make up the maſs of reſpiration, and are, when mixed together, harmleſs; but any one of them, for a long

long time ſingly predominant, becomes at length fatal.

The effects of heat in producing a noxious quality in the air, are well known. Thoſe torrid regions under the Line, are always unwholeſome. At Senegal the natives conſider forty as a very advanced time of life, and generally die of old age at fifty. At Carthagena, in America, where the heat of the hotteſt day ever known in Europe is continual, where, during their winter ſeaſon, theſe dreadful heats are united with a continual ſucceſſion of thunder, rain, and tempeſts, ariſing from their intenſeneſs, the wan and livid complexions of the inhabitants might make ſtrangers ſuſpect that they were juſt recovered from ſome dreadful diſtemper; the actions of the natives are conformable to their colour; in all their motions there is ſomewhat relaxed and languid; the heat of the climate even affects their ſpeech, which is ſoft and ſlow, and their words generally broken. Travellers from Europe retain their ſtrength and ruddy colour in that climate, poſſibly for three or four months; but afterwards ſuffer ſuch decays in both, that they are no longer to be diſtinguiſhed from the inhabitants by their complexion. However, this languid and ſpiritleſs exiſtence is frequently drawled on ſometimes even to eighty. Young perſons are generally moſt affected by the heat of climate, which ſpares the more aged; but all, upon their arrival on the coaſts, are ſubject to the ſame train of fatal diſorders. Few nations have experienced the mortality of theſe coaſts, ſo much as our own: in our unſucceſsful attack upon Carthagena, more than three parts of our army were deſtroyed by the climate alone; and thoſe that returned from that fatal expedition, found their former vigour irretrievably gone. In our more fortunate expedition, which gave us the Havannah, we had little reaſon to boaſt of our ſucceſs; inſtead of a third, not a fifth part of the army were left ſurvivors of their victory, the climate being an enemy that even heroes cannot conquer.

The diſtempers that thus proceed from the cruel malignity of thoſe climates are many; that, for inſtance, called the Chapotonadas, carries off a multitude of people; and extremely thins the crews of European ſhips, whom gain tempts into thoſe inhoſpitable regions. The nature of this diſtemper is but little known, being cauſed in ſome perſons by cold, in others by indigeſtion. But its effects are far from being obſcure; it is generally fatal in three or four days: upon its ſeizing the patient, it brings on what is there called the black vomit, which is the ſad ſymptom after which none are ever found to recover. Some, when the vomit attacks them, are ſeized with a delirium, that, were they not tied down, they would tear themſelves to pieces, and thus expire in the midſt of this furious paroxyſm. This diſorder, in milder climates, takes the name of the bilious fever, and is intended with milder ſymptoms, but very dangerous in all.

There are many other diſorders incident to the human body, that ſeem the offspring of heat; but to mention no other, that very laſſitude which prevails in all the tropical climates, may be conſidered as a diſeaſe. The inhabitants of India, ſays a modern philoſopher, ſuſtain an unceaſing languor, from the heats of their climate; and are torpid in the midſt of profuſion. For this reaſon, the great Diſpoſer of Nature has cloathed their country with trees of an amazing height, whoſe ſhade might defend them from the beams of the ſun; and whoſe continual freſhneſs might, in ſome meaſure, temperate their fierceneſs. From theſe ſhades, therefore, the air receives refreſhing moiſture, and animals a cooling protection. The whole race of ſavage animals retire, in the midſt of the day, to the very center of the foreſts, not ſo much to avoid their enemy man, as to find a defence againſt the raging heats of the ſeaſon. This advantage which ariſes from ſhade in torrid climates, may probably afford a ſolution for that extraordinary circumſtance related by Boyle, which he imputes to a different cauſe. In the iſland of Ternate, belonging to the Dutch, a place that had been long celebrated for its beauty and healthfulneſs, the clove-trees grew in ſuch plenty, that they in ſome meaſure leſſened their own value: for this reaſon, the Dutch reſolved to cut down the foreſts, and thus to raiſe the price of the commodity: but they had ſoon reaſon to repent of their avarice; for ſuch a change enſued, by cutting down the trees, that the whole iſland, from being healthy and delightful, having loſt its charming ſhades, became extremely ſickly, and has actually continued ſo to this day. Boerhaave conſidered heat ſo prejudicial to health, that he was never ſeen to go near a fire.

An oppoſite ſet of calamities are the conſequence, in climates where the air is condenſed by cold. In ſuch places, all that train of diſtempers which are known to ariſe from obſtructed perſpiration, are very common; eruptions, boils, ſcurvy, and a loathſome leproſy, that covers the whole body with a ſcurf, and white putrid ulcers. Theſe diſorders alſo are infectious; and, while they thus baniſh the patient from ſociety, they generally accompany him to the grave. The men of thoſe climates ſeldom attain to the age of fifty; but the women, who do not lead ſuch laborious lives, are found to live longer.

The autumnal complaints which attend a wet ſummer, indicate the dangers of a moiſt air. The long continuance of an eaſt wind alſo, ſhews the prejudice of a dry one. Mineral exhalations, when copious, are every where known to be fatal; and although we probably owe the increaſe and luxuriance of vegetation to a moderate degree of their warmth, yet the natives of thoſe countries where there are mines in plenty, but too often experience the noxious effects of their vicinity. Thoſe trades alſo that deal in the preparations of metals of all kinds, are always unwholeſome; and the workmen, after ſome time, are generally ſeen to labour under palſies, and other nervous complaints. The vapours from ſome vegetable ſubſtances, are well known to be attended with dangerous effects. The ſhade of the machinel-tree, in America, is ſaid to be fatal; as was that of the juniper, if we may credit the ancients. Thoſe who walk through fields of poppies, or in any manner prepare thoſe flowers, for making opium, are very ſenſibly affected with the drowſineſs they occaſion. A phyſician of Mr. Boyle's acquaintance, cauſing a large quantity of black hellebore to be pounded in a mortar, moſt of the perſons who were in the room, and eſpecially the perſon who pounded it, were purged by it, and ſome of them ſtrongly. He alſo gathered a certain plant in Ireland, which the perſon who beat in a mortar, and the phyſician who was ſtanding near, were ſo ſtrongly affected by, that their hands and faces ſwelled to an enormous ſize, and continued tumid for a long time after.

But neither mineral nor vegetable ſteams are ſo dangerous to the conſtitution, as thoſe proceeding from animal ſubſtances, putrifying either by diſeaſe or death. The effluvia that comes from diſeaſed bodies, propagate that frightful catalogue of diſorders which are called infectious. The parts which compoſe vegetable vapours, and mineral exhalations, ſeem groſs and heavy, in compariſon of theſe volatile vapours, that go to great diſtances, and have been deſcribed as ſpreading

deſolation over the whole earth. They fly every where; penetrate every where; and the vapours that fly from a ſingle diſeaſe, ſoon render it epidemic.

The plague is the firſt upon the liſt in this claſs of human calamities. From whence this ſcourge of man's preſumption may have its beginning, is not well known; but we well know that it is propagated by infection. Whatever be the general ſtate of the atmoſphere, we learn from experience, that the noxious vapours, though but ſingly introduced at firſt, taints the air by degrees: every perſon infected, tends to add to the growing malignity; and, as the diſorder becomes more general, the putreſcence of the air becomes more noxious, ſo that the ſymptoms are aggravated by continuance. When it is ſaid that the origin of this diſorder is unknown, it implies, that the air ſeems to be but little employed in firſt producing it. There are ſome countries, even in the midſt of Africa, that we learn have never been infected with it; but continue, for centuries, unmoleſted. On the contrary, there are others, that are generally viſited once a year, as in Egypt, which, nevertheleſs, ſeems peculiarly bleſſed with the ſerenity and temperature of its climate. In the former countries, which are of vaſt extent, and many of them very populous, every thing ſhould ſeem to diſpoſe the air to make the plague continual among them. The great heats of the climate, the unwholeſomeneſs of the food, the ſloth and dirt of the inhabitants, but, above all, the bloody battles which are continually fought among them, after which heaps of dead bodies are left unburied, and expoſed to putrefaction. All theſe one might think would be apt to bring the plague among them; and yet, nevertheleſs, we are aſſured by Leo Africanus, that in Numidia the plague is not known once in an hundred years; and that in Negroland, it is not known at all. This dreadful diſorder, therefore, muſt have its riſe, not from any previous diſpoſition of the air, but from ſome particular cauſe, beginning with one individual, and extending the malignity, by communication, till at laſt the air becomes actually tainted by the generality of the infection.

The plague which ſpread itſelf over the whole world, in the year 1346, as we are told by Mezeray, was ſo contagious, that ſcarce a village, or even an houſe, eſcaped being infected by it. Before it had reached Europe, it had been for two years travelling from the great kingdom of Cathay, where it began by a vapour moſt horridly fœtid; this broke out of the earth like a ſubterranean fire, and upon the firſt inſtant of its eruption, conſumed and deſolated above two hundred leagues of that country, even to the trees and ſtones.

In that great plague which deſolated the city of London, in the year 1665, a pious and learned ſchoolmaſter of Mr. Boyle's acquaintance, who ventured to ſtay in the city, and took upon him the humane office of viſiting the ſick and the dying, who had been deſerted by better phyſicians, averred, that being once called to a poor woman who had buried her children of the plague, he found the room where ſhe lay ſo little that it ſcarce could hold any more than the bed whereon ſhe was ſtretched. However, in this wretched abode, beſide her, in an open coffin, her huſband lay, who had ſome time before died of the ſame diſeaſe; and whom ſhe, poor creature, ſoon followed. But what ſhewed the peculiar malignity of the air, thus ſuffering from animal putrefaction, was, that the contagious ſteams had produced ſpots on the very wall of their wretched apartment: and Mr. Boyle's own ſtudy, which was contiguous to a peſt-houſe, was alſo ſpotted in the ſame frightful manner. Happily for mankind, this diſorder, for more than a century

has not been known in our iſland; and, for this laſt age, has abated much of its violence, even in thoſe countries where it is moſt common. Diſeaſes, like empires, have their revolutions; and thoſe which for a while were the ſcourge of mankind, ſink unheard of, to give place to new ones, more dreadful, as being leſs underſtood.

For this revolution in diſorders, which has employed the ſpeculation of many, Mr. Boyle accounts in the following manner: "Since," ſays he, "there want not cauſes in the bowels of the earth, to make conſiderable changes amongſt the materials that nature has plentifully treaſured up in thoſe magazines, and as thoſe noxious ſteams are abundantly ſupplied to the ſurface, it may not ſeem improbable, that in this great variety, ſome may be found capable of particularly affecting the human frame in a particular manner, and thus of producing new diſeaſes. The duration of theſe may be greater or leſs, according to the laſtingneſs of thoſe ſubterraneous cauſes that produced them. On which account, it need be no wonder that ſome diſeaſes have but a ſhort duration, and vaniſh not long after they appear; whilſt others may continue longer, as having under ground more ſettled and durable cauſes to maintain them."

From the recital of this train of miſchiefs produced by the air, upon minerals, plants, animals, and man himſelf, a gloomy mind may be apt to dread this indulgent nurſe of nature as a cruel and an inexorable ſtep-mother: but it is far otherwiſe; and, although we are ſometimes injured, yet almoſt all the comforts and bleſſings of life ſpring from its propitious influence. It would be needleſs to obſerve, that it is abſolutely neceſſary for the ſupport of our lives; for of this, every moment's experience aſſures us. But how it contributes to this ſupport, is not ſo readily comprehended. All allow it to be a friend, to whoſe benefits we are conſtantly obliged: and yet, to this hour, philoſophers are divided as to the nature of the obligation. The diſpute is, whether the air is only uſeful by its weight to force our juices into circulation; or, whether, by containing a peculiar ſpirit, it mixes with the blood in our veſſels, and acts like a ſpur to their induſtry. Perhaps it may exert both theſe uſeful offices at the ſame time. Its weight may give the blood its progreſſive motion, through the larger veſſels of the body; and its admixture with it, cauſe thoſe contractions of all the veſſels, which ſerve to force it ſtill more ſtrongly forward, through the minuteſt channels of the circulation. Be this as it may, it is well known, that that part of our blood which has juſt received the influx of the air in our bodies, is of a very different colour from that which has almoſt performed its circuit. It has been found, that the arterial blood which has been immediately mixed with the air in the lungs, and, if we may ſo expreſs it, is juſt beginning its journey through the body, is of a fine florid ſcarlet colour; while, on the contrary, the blood of the veins that is returning from having performed its duty, is of a blackiſh crimſon hue. Whence this difference of colour ſhould proceed, is not well underſtood; we only know the fact, that this florid colour is communicated by the air; and we are well convinced, that this air has been admitted into the blood for very uſeful purpoſes.

Beſides this vital principle in animals, the air alſo gives life and body to flame. A candle quickly goes out in an exhauſted receiver; for having ſoon conſumed the quantity of air, it then expires, for want of a freſh ſupply. There has been a flame contrived that will burn under water; but none yet has been found, that will continue to burn without air. Gunpowder, which is the moſt catching and powerful fire we know, will not go off in an exhauſted

hauſted receiver; nay, if a train of gunpowder be laid, ſo as that one part may be fired in the open air, yet the other part in vacuo will remain untouched, and unconſumed. Wood alſo ſet on fire, immediately goes out; and its flame ceaſes upon removing the air; for ſomething is then wanting to preſs the body of the fire againſt that of the fuel, and to prevent the too ſpeedy diffuſion of the flame. We frequently ſee cooks, and others, whoſe buſineſs it is to keep up ſtrong fires, take proper precautions to exclude the beams of the ſun from ſhining upon them, which effectually puts them out. This they are apt to aſcribe to a wrong cauſe; namely, the operation of the light: but the real fact is, that the warmth of the ſun-beams leſſen and diſſipate the body of the air that goes to feed the flame; and the fire, of conſequence, languiſhes for want of a neceſſary ſupply.

The air, while it thus kindles fire into flame, is notwithſtanding found to moderate the rays of light, to diſſipate their violence, and to ſpread an uniform luſtre over every object. Were the beams of the ſun to dart directly upon us, without paſſing through this protecting medium, they would either burn us up at once, or blind us with their effulgence. But by going through the air, they are reflected, refracted, and turned from their direct courſe, a thouſand different ways; and thus are more evenly diffuſed over the face of nature.

Among the other neceſſary benefits the air is of to us, one of the principal is its conveyance of ſound. Even the vibrations of a bell, which have the loudeſt effect that we know of, ceaſes to be heard, when under the receiver of an air-pump. Thus all the pleaſures we receive from converſation with each other, or from muſic, depend entirely upon the air.

Odours likewiſe are diffuſed only by the means of air; without this fluid to ſwim in, they would for ever remain torpid in their reſpective ſubſtances; and the roſe would affect us with as little ſenſations of pleaſure, as the thorn on which it grew.

Thoſe who are willing to augment the catalogue of the benefits we receive from this element, aſſert alſo, that taſtes themſelves would be inſipid, were it not that the air preſſes their parts upon the nerves of the tongue and palate, ſo as to produce their grateful effects. Thus, continue they, upon the tops of high mountains, as on the Pike of Teneriff, the moſt poignant bodies, as pepper, ginger, ſalt, and ſpice, have no ſenſible taſte, for want of their particles being thus ſent home to the ſenſory. But we owe the air ſufficient obligations, not to be ſtudious of admitting this among the number: in fact, all ſubſtances have their taſte, as well on the tops of mountains, as in the bottom of the valley; and ſeveral have been known to eat a good dinner on the Alps.

It is ſufficient, therefore, that we regard the air as the parent of health and vegetation; as a kind diſpenſer of light and warmth; and as the conveyer of ſounds and odours. This is an element of which avarice will not deprive us; and which power cannot monopolize. The treaſures of the earth, the verdure of the fields, and even the refreſhments of the ſtream, are too often ſeen going only to aſſiſt the luxuries of the great; while the leſs fortunate part of mankind ſtand humble ſpectators of their encroachments. But the air no limitations can bound, nor any land-marks reſtrain. In this benign element, all mankind can boaſt an equal poſſeſſion; and for this we all have equal obligations to Heaven. We conſume a part of it, for our own ſuſtenance, while we live; and, when we die, our putrifying bodies give back the ſupply, which, during life, we had accumulated from the general maſs.

CHAP. XX.

Of Regular and Irregular WINDS.

WIND is a current of air. Experimental philoſophers produce an artificial wind, by an inſtrument called an æolipyle. This is nothing more than an hollow copper ball, with a long pipe; a tea-kettle might be readily made into one, if it were entirely cloſed at the lid, and the ſpout left open; through this ſpout it is to be filled with water, and then ſet upon the fire, by which means it produces a violent blaſt, like wind, which continues while there is any water remaining in the inſtrument. In this manner water is converted into a ruſhing air; which, if caught as it goes out, and left to cool, is again quickly converted into its former element. Beſides this, as was mentioned in the former chapter, almoſt every ſubſtance contains ſome portions of air. Vegetables, or the bodies of animals left to putrify, produce it in a very copious manner. But it is not only ſeen thus eſcaping from bodies, but it may be very eaſily made to enter into them. A quantity of air may be compreſſed into water, ſo as to be intimately blended with it. It finds a much eaſier admiſſion into wine, or any fermented liquor; and an eaſier ſtill, into ſpirits of wine. Some ſalts ſuck up the air in ſuch quantities, that they are made ſenſibly heavier thereby, and often are melted by its moiſture. In this manner, moſt bodies, being found either capable of receiving or affording it, we are not to be ſurprized at thoſe ſtreams of air that are continually fleeting round the globe. Minerals, vegetables, and animals, contribute to increaſe the current; and are ſending off their conſtant ſupplies. Theſe, as they are differently affected by cold or heat, by mixture or putrefaction, all yield different quantities of air at different times; and the loudeſt tempeſts, and moſt rapid whirlwinds, are formed for their united contributions.

The ſun is the principal inſtrument in rarefying the juices of plants, ſo as to give an eſcape to their impriſoned air; it is alſo equally operative in promoting the putrefaction of animals. Mineral exhalations are more frequently raiſed by ſubterranean heat. The moon, the other planets, the ſeaſons, are all combined in producing theſe effects in a ſmaller degree. Mountains give a direction to the courſes of the air. Fires carry a current of air along their body. Night and day alternately chill and warm the earth, and produce an alternate current of its vapours. Theſe, and many other cauſes, may be aſſigned for the variety, and the activity of the winds, their continual change, and uncertain duration.

With us on land, as the wind proceeds from ſo many cauſes, and meets ſuch a variety of obſtacles, there can be but little hopes of ever bringing its motions to conform to theory; or of foretelling how it may blow a minute to come. The great Bacon, indeed, was of opinion, that by a cloſe and regular hiſtory of the winds, continued for a number of ages together, and the particulars of each obſervation reduced to general maxims, we might at laſt come to underſtand the variations of this capricious element; and that we could foretell the certainty of a wind, with as much eaſe as we now foretell the return of an eclipſe. Indeed, his own beginnings in this arduous undertaking, ſeem to ſpeak the poſſibility of ſucceſs; but, unhappily for mankind, this inveſtigation is the work of ages, and we want a Bacon to direct the proceſs.

To be able, therefore, with any plauſibility, to account for the variations of the wind upon land, is not to be at preſent expected; and to underſtand any thing of their nature, we muſt have recourſe to

thoſe

thoſe places where they are more permanent and ſteady. This uniformity and ſteadineſs we are chiefly to expect upon the ocean. There, where there is no variety of ſubſtances to furniſh the air with various and inconſtant ſupplies; where there are no mountains to direct the courſe of its current, but where all is extenſively uniform and even; in ſuch a place, the wind ariſing from a ſimple cauſe, muſt have but one ſimple motion. In fact, we find it ſo. There are many parts of the world where the winds, that with us are ſo uncertain, pay their ſtated viſits. In ſome places, they are found to blow one way by day, and another by night; in others, for one-half of the year, they go in a direction contrary to their former courſe: but what is more extraordinary ſtill, there are ſome places where the winds never change, but for ever blow the ſame way. This is particularly found to obtain between the tropics in the Atlantic and Æthiopic oceans; as well as in the great Pacific ſea.

Few things can appear more extraordinary to a perſon who has never been out of our variable latitudes, than this ſteady wind, that for ever ſits in the ſail, ſending the veſſel forward; and as effectually preventing its return. He who has been taught to conſider that nothing in the world is ſo variable as the winds, muſt certainly be ſurpriſed to find a place where there is nothing more uniform. With us their inconſtancy has become a proverb; with the natives of thoſe diſtant climates, they may talk of a friend or a miſtreſs as fixed and unchangeable as the winds, and mean a compliment by the compariſon. When our ſhips are once arrived into the proper latitudes of the great Pacific ocean, the mariner forgets the helm, and his ſkill becomes almoſt uſeleſs: neither ſtorms nor tempeſts are known to deform the glaſſy boſom of that immenſe ſheet of waters; a gentle breeze, that for ever blows in the ſame direction, reſts upon the canvas, and ſpeeds the navigator. In the ſpace of ſix weeks, ſhips are thus known to croſs an immenſe ocean, that takes more than ſo many months to return. Upon returning, the trade-wind, which has been propitious, is then avoided; the mariner is generally obliged to ſteer into the northern latitudes, and to take the advantage of every caſual wind that offers, to aſſiſt him into port. This wind, which blows with ſuch conſtancy one way, is known to prevail not only in the Pacific ocean, but alſo in the Atlantic, between the coaſts of Guinea and Braſil; and, likewiſe, in the Æthiopic ocean. This ſeems to be the great univerſal wind, blowing from the eaſt to the weſt, that prevails in all the extenſive oceans, where the land does not frequently break the general current. Were the whole ſurface of the globe an ocean, there would probably be but this one wind, for ever blowing from the eaſt, and purſuing the motions of the ſun weſtward. All the other winds ſeem ſubordinate to this; and many of them are made from the deviations of its current. To form, therefore, any conception relative to the variations of the wind in general, it is proper to begin with that which never varies.

There have been many theories to explain this invariable motion of the winds; among the reſt, we cannot omit that of Doctor Lyſter, for its ſtrangeneſs: "The ſea," ſays he, "in thoſe latitudes, is generally covered over with green weeds, for a great extent; and the air produced from the vegetable perſpiration of theſe, produces the trade-wind." The theory of Carteſius was not quite ſo abſurd. He alledged, that the earth went round faſter than its atmoſphere at the equator; ſo that its motion, from weſt to eaſt, gave the atmoſphere an imaginary one from eaſt to weſt; and thus an eaſt wind was eternally ſeen to prevail. Rejecting thoſe arbitrary opinions, conceived without force,

and aſſerted without proof, Doctor Halley has given one more plauſible; which ſeems to be the reigning ſyſtem of the day.

To conceive his opinion clearly, let us for a moment ſuppoſe the whole ſurface of the earth to be an ocean, and the air encompaſſing it on every ſide, without motion. Now it is evident, that that part of the air which lies directly under the beams of the ſun, will be rarefied; and if the ſun remained for ever in the ſame place, there would be a great vacuity in the air (if it may be ſo expreſſed) beneath the place where the ſun ſtood. The ſun moving forward, from eaſt to weſt, this vacuity will follow too, and ſtill be made under it. But while it goes on to make new vacuities, the air will ruſh in to fill up thoſe the ſun has already made; in other words, as it is ſtill travelling forward, the air will continually be ruſhing in behind, and purſue its motions from eaſt to weſt. In this manner, the air is put into motion by day; and by night, the parts continue to impel each other, till the next return of the ſun, that gives a new force to the circulation.

In this manner is explained the conſtant eaſt wind that is found blowing round the globe, near the equator. But it is alſo known, that as we recede from the equator on either ſide, we come into a trade-wind, that continually blows from the poles, from the north on one ſide, or the ſouth on the other, both directing towards the equator. This alſo proceeds from a ſimilar cauſe with the former; for the air being more rarefied in thoſe places over which the ſun more directly daats its rays, the currents will come both from the north and the ſouth to fill up the intermediate vacuity.

Theſe two motions, namely, the general one from eaſt to weſt, and the more particular one from both the poles, will account for all the phænomena of trade-winds; which, if the whole ſurface of the globe were ſea, would undoubtedly be conſtant, and for ever continue to blow in one direction. But there are a thouſand circumſtances to break theſe air-currents into ſmaller ones; to drive them back againſt their general courſe; to raiſe or depreſs them; to condenſe them into ſtorms; or to whirl them in eddies. In conſequence of this, regard muſt be often had to the nature of the ſoil, the poſition of the high mountains, the courſe of the rivers, and even to the luxuriance of vegetation.

If a country lying directly under the ſun, be very flat and ſandy, and if the land be low and extenſive, the heats occaſioned by the reflection of the ſun-beams, produces a very great rarefaction of the air. The deſarts of Africa, which are conformable to this deſcription, are ſcarce ever fanned by a breath of wind by day; but the burning ſun is continually ſeen blazing in intolerable ſplendor above them. For this reaſon, all along the coaſts of Guinea, the wind is always perceived blowing in upon land, in order to fill up the vacuity cauſed by the ſun's operation. In thoſe ſhores, therefore, the wind blows in a contrary direction to that of its general current; and is conſtantly found ſetting in from the weſt.

From the ſame cauſe it happens, that thoſe conſtant calms, attended with deluges of rain, are found in the ſame part of the ocean. For this tract being placed in the middle, between the weſterly winds blowing on the coaſt of Guinea, and the eaſterly trade-winds that move at ſome diſtance from ſhore, in a contrary direction, the tendency of that part of the air that lies between theſe two oppoſite currents, is indifferent to either, and ſo reſts between both in torpid ſerenity; and the weight of the incumbent atmoſphere, being diminiſhed by the continual contrary winds blowing from hence,

it is unable to keep the vapours ſuſpended that are copiouſly borne thither; ſo that they fall in continual rains.

But it is not to be ſuppoſed, that any theory can account for all the phænomena of even thoſe winds that are known to be moſt regular. Inſtead of a complete ſyſtem of the trade-winds, we muſt rather be content with an imperfect hiſtory. Theſe, as was ſaid, being the reſult of a combination of effects, aſſume as great a variety as the cauſes producing them are various.

Beſides the great general wind above mentioned, in thoſe parts of the Atlantic that lie under the temperate zone, a north wind prevails conſtantly during the months of October, November, December, and January. Theſe, therefore, are the moſt favourable months for embarking for the Eaſt-Indies, in order to take the benefit of theſe winds, for croſſing the line: and it has been often found, by experience, that thoſe who had ſet ſail five months before, were not in the leaſt farther advanced in their voyage, than thoſe who waited for the favourable wind. During the winter of Nova Zembla, and the other arctic countries, a north wind reigns almoſt continually. In the Cape de Verde iſlands, a ſouth wind prevails during the month of July. At the Cape of Good Hope, a north-weſt wind blows during the month of September. There are alſo regular winds, produced by various cauſes, upon land. The ancient Greeks were the firſt who obſerved a conſtant breeze, produced by the melting of the ſnows, in ſome high neighbouring countries. This was perceived in Greece, Thrace, Macedonia, and the Ægean ſea. The ſame kind of winds are now remarked in the kingdom of Congo, and the moſt ſouthern parts of Africa. The flux and reflux of the ſea alſo produces ſome regular winds, that ſerve the purpoſes of trade; and, in general, it may be obſerved, that wherever there is a ſtrong current of water, there is a current of air that ſeems to attend it.

Beſides theſe winds that are found to blow in one direction, there are, as was ſaid before, others that blow for certain months of the year one way, and the reſt of the year the contrary way; theſe are called the Monſoons, from a famous pilot of that name, who firſt uſed them in navigation with ſucceſs. In all that part of the ocean that lies between Africa and India, the eaſt winds begin at the month of January, and continue till about the commencement of June. In the month of Auguſt, or September, the contrary direction takes place; and the weſt winds prevail for three or four months. The interval between theſe winds, that is to ſay, from the end of June to the beginning of Auguſt, there is no fixed wind; but the ſea is uſually toſſed by violent tempeſts, proceeding from the north. Theſe winds are always ſubject to their greateſt variations, as they approach the land; ſo that on one ſide of the great peninſula of India, the coaſts are, for near half the year, harraſſed by violent hurricanes, and northern tempeſts; while, on the oppoſite ſide, and all along the coaſts of Coromandel, theſe dreadful tempeſts are wholly unknown. At Java, and Ceylon, a weſt wind begins to reign in the month of September; but at fifteen degrees of ſouth latitude, this wind is found to be loſt, and the great general trade wind from the eaſt, is perceived to prevail. On the contrary, at Cochin, in China, the weſt wind begins at March: ſo that theſe Monſoons prevail, at different ſeaſons, throughout the Indies. So that the mariner takes one part of the year to go from Java to the Moluccas; another from Cochin to Molucca, another from Molucca to China; and ſtill another, to direct him from China to Japan.

There are winds alſo that may be conſidered as peculiar to certain coaſts: for example, the ſouth wind is almoſt conſtant upon the coaſts of Chili and Peru; weſtern winds almoſt conſtantly prevail on the coaſt of Terra Magellanica; and in the environs of the Streights le Maire. On the coaſts of Malabar, north and north-weſt winds prevail continually; along the coaſt of Guinea, the north-weſt wind is alſo very frequent; and, at a diſtance from the coaſts, the north-eaſt is alway found prevailing. From the beginning of November to the end of December, a weſt wind prevails on the coaſts of Japan; and, during the whole winter, no ſhips can leave the port of Cochin, on account of the impetuoſity of the winds that ſet upon the coaſt. Theſe blow with ſuch vehemence, that the ports are entirely choaked up with ſand, and even boats are not able to enter. However, the eaſt winds that prevail for the other half of the year, clear the mouths of the harbours from the accumulations of the preceding winter, and ſet the confined ſhips at liberty. At the Streights of Babelmandel there is a ſouth wind, that periodically returns, and which is always followed by a north-eaſt.

Beſides winds thus peculiar to certain coaſts, there are others found to prevail on all the coaſts, in warm climates; which, during one part of the day, blow from the ſhore, and, during another part of it, blow from the ſea. The ſea-breeze, in thoſe countries, as Dampier obſerves, commonly riſes in the morning, about nine, proceeding ſlowly, in a fine ſmall black curl, upon the ſurface of the water, and making its way to refreſh the ſhore. It is gentle at firſt, but increaſes gradually till twelve, then inſenſibly ſinks away, and is totally huſhed at five. Upon its ceaſing, the land breeze begins to take its turn, which increaſes till twelve at night, and is ſucceeded, in the morning, by the ſea breeze again. Without all doubt nothing could have been more fortunate, for the inhabitants of the warm countries, where thoſe breezes blow, than this alternate refreſhment, which they feel at thoſe ſeaſons when it is moſt wanted. The heat, on ſome coaſts, would be inſupportable, were it not for ſuch a ſupply of air, when the ſun has rarefied all that which lay more immediately under the coaſt. The ſea-breeze temperates the heat of the ſun by day; and the land-breeze corrects the malignity of the dews, and vapours, by night. Where theſe breezes, therefore, prevail, and they are very common, the inhabitants enjoy a ſhare of health and happineſs, unknown to thoſe that live much farther up the country, or ſuch as live in ſimilar latitudes without this advantage. The cauſe of theſe obviouſly ſeems to ariſe from the rarefaction of the air by the ſun, as their duration continues with its appearance, and alters when it goes down. The ſun, it is obſerved, equally diffuſing his beams upon land and ſea, the land, being a more ſolid body than the water, receives a greater quantity of heat, and reflects it more ſtrongly. Being thus, therefore, heated to a greater degree than the waters, it, of conſequence, drives the air from land out to ſea; but, its influence being removed, the air returns to fill up the former vacuity. Such is the uſual method of accounting for this phænomenon; but, unfortunately, theſe ſea and land breezes are viſitants that come at all hours. On the coaſts of Malabar, the land-breezes begin at midnight, and continue till noon; then the ſea-breezes take their turn, and continue till midnight. While, again, at Congo, the land-breezes begin at five, and continue till nine the next day.

But, if the cauſe of theſe be ſo inſcrutable, that are, as we ſee, tolerably regular in their viſitations, what ſhall we ſay to the winds of our own climate, that are continually ſhifting, and incapable of reſt? Some general cauſes may be aſſigned, which nothing but particular experience can apply. And, in the firſt place, it may be obſerved, that clouds, and

and heat; and, in short, whatever either increases the density or the elasticity of the air, in any one place, will produce a wind there: for the increased activity of the air thus pressing more powerfully on the parts of it that are adjacent, will drive them forward; and thus go on, in a current, till the whole comes to an equality.

In this manner, as a denser air produces a wind, on the one hand; so will any accident, that contributes to lighten the air, produce it on the other: for a lighter air may be considered as a vacuity, into which the neighbouring air will rush: and hence it happens, that when the barometer marks a peculiar lightness in the air, it is no wonder that it foretells a storm.

The winds upon large waters are generally more regular than those upon land. The wind at sea generally blows with an even steady gale; the wind at land puffs by intervals, increasing its strength, and remitting it, without any apparent cause. This, in a great measure, may be owing to the many mountains, towers, or trees, that it meets in its way, all contributing either to turn it from its course, or interrupt its passage.

The east wind blows more constantly than any other, and for an obvious reason: all other winds are, in some measure, deviations from it, and partly may owe their origin thereto. It is generally, likewise, the most powerful, and for the same reason.

There are often double currents of the air. While the wind blows one way, we frequently see the clouds move another. This is generally the case before thunder; for it is well known that the thunder cloud always moves against the wind: the cause of this surprising appearance has hitherto remained a secret. From hence we may conclude, that weathercocks only inform us of that current of the air, which is near the surface of the earth, but are often erroneous with regard to the upper regions; and, in fact, Derham has often found them erroneous.

Winds are generally more powerful on elevated situations than on the plain, because their progress is interrupted by fewer obstacles. In proportion as we ascend the heights of a mountain, the violence of the weather seems to increase, until we have got above the region of storms, where all is usually calm and serene. Sometimes, however, the storms rise even to the tops of the highest mountains; as we learn from those who have been on the Andes, and as we are convinced by the deep snows that crown even the highest.

Winds blowing from the sea are generally moister, and more attended with rains, than those which blow over extensive tracts of land: for the sea gives off more vapours to the air, and these are rolled forward upon land, by the winds blowing from thence. For this reason our easterly winds, that blow from the continent, are dry, compared with those that blow from the surface of the ocean, with which we are surrounded on every other quarter.

In general the winds are more boisterous in spring and autumn, than at other seasons: for, that being the time of high tides, the sea may communicate a part of its motions to the winds. The sun and moon also, which then have a greater effect upon the waters, may also have some influence upon the winds; for, there being a great body of air surrounding the globe, which, if condensed into water, would cover it to the depth of thirty-two feet, it is evident that the sun and moon will, to a proportionable degree, affect the atmosphere, and make a tide of air. This tide will be scarce perceivable, indeed, but, without doubt, it actually exists; and may contribute to increase the vernal and autumnal storms, which are then known to prevail.

Upon narrowing the passage through which the air is driven, both the density and the swiftness of the wind is increased. For as currents of water flow with greater force and rapidity by narrowing their channels, so also will a current of air, driven through a contracted space, grow more violent and irresistible. Hence we find those dreadful storms that prevail in the defiles of mountains, where the wind, pushing from behind through a narrow channel, at once increases in speed and density, levelling, or tearing up, every obstacle that rises to obstruct its passage.

Winds reflected from the sides of mountains and towers, are often found to be more forceful than those in direct progression. This we frequently perceive near lofty buildings, such as churches or steeples, where winds are generally known to prevail, and that much more powerful than at some distance. The air, in this case, by striking against the side of the building, acquires additional density, and therefore blows with more force.

These differing degrees of density, which the air is found to possess, sufficiently shew that the force of the winds do not depend upon their velocity alone, so that those instruments called anemometers, which are made to measure the velocity of the wind, will by no means give us certain information of the force of the storm. In order to estimate this with exactness, we ought to know its density; which also these are not calculated to discover. For this reason we often see storms, with very powerful effects, that do not seem to shew any great speed; and on the contrary, we see these wind measurers go round, with great swiftness, when scarce any damage has followed from the storm.

Such is the nature, and the inconstancy of the irregular winds with which we are best acquainted. But their effects are much more formidable in those climates, near the tropics, where they are often found to break in upon the steady course of the trade winds, and to mark their passage with destruction. With us the tempest is but rarely known, and its ravages are registered as an uncommon calamity; but, in the countries that lie between the tropics, and for a good space beyond them, its visits are frequent, and its effects anticipated. In these regions the winds vary their terrors, sometimes involving all things in a suffocating heat, sometimes mixing all the elements of fire, air, earth, and water together; sometimes, with a momentary swiftness, passing over the face of the country, and destroying all things in their passage, and sometimes raising whole sandy deserts in one country, to deposit them upon some other. We have little reason, therefore, to envy these climates the luxuriance of their soil, or the brightness of their skies. Our own muddy atmosphere, that wraps us round in obscurity, though it fails to gild our prospects with sun-shine, or our groves with fruitage, nevertheless answers the calls of industry. They may boast of a plentiful, but precarious harvest, while, with us, the labourer toils in a certain expectation of a moderate, but an happy return.

In Egypt, a kingdom so noted for its fertility, and the brightness of its atmosphere, during summer, the south winds are so hot, that they almost stop respiration; besides which, they are charged with such quantities of sand, that they sometimes darken the air, as with a thick cloud. These sands are so fine, and driven with such violence, that they penetrate every where; even into chests, be they shut never so closely. If these winds happen to continue for any length of time, they produce epidemic diseases, and are often followed by great mortality.

mortality. It is alſo found to rain but very ſeldom in that country; however, the want of ſhowers is richly compenſated by the copiouſneſs of their dews, which greatly tend to promote vegetation.

In Perſia, the winter begins in November, and continues till March. The cold at that time is intenſe enough to congeal the water; and ſnow falls in abundance upon their mountains. During the months of March and April, winds ariſe, that blow with great force, and ſeem to uſher in the heats of ſummer. Theſe return again, in autumn, with ſome violence; without, however, producing any dreadful effects. But, during their ſummer, all along the coaſts of the Perſian Gulph, a very dangerous wind prevails, which the natives call the Sameyel, ſtill more dreadful and burning than that of Egypt, and attended with inſtant and fatal effects. This terrible blaſt, which was, perhaps, the peſtilence of the ancients, inſtantly kills all thoſe that it involves in its paſſage. What its malignity conſiſts in, none can tell, as none have ever ſurvived its effects, to give information. It frequently aſſumes a viſible form; and darts, in a kind of bluiſh vapour, along the ſurface of the country. The natives not only of Perſia, but Arabia, talk of its effects with terror; and their poets have not failed to heighten them, with the aſſiſtance of imagination. They have deſcribed it as under the conduct of a miniſter of vengeance, who governs its terrors, and raiſes, or depreſſes it, as he thinks proper. Theſe deadly winds are alſo known along the coaſts of India, at Necapatan, Maſulipatan, and Petapoli. But, luckily for mankind, the ſhortneſs of their duration diminiſhes the injuries that might enſue from their malignity.

The Cape of Good Hope, as well as many iſlands in the Weſt-Indies, are famous for their hurricanes, and that extraordinary kind of cloud, which is ſaid to produce them. This cloud, which is the forerunner of an approaching hurricane, appears, when firſt ſeen, like a ſmall black ſpot on the verge of the horizon, and is called, by ſailors, the bull's eye, from being ſeen ſo minute at a vaſt diſtance. All this time, a perfect calm reigns over the ſea and land, while the cloud grows gradually broader as it approaches. At length, coming to the place where its fury is to fall, it inveſts the whole horizon with darkneſs. During all the time of its approach, an hollow murmur is heard in the cavities of the mountains: and beaſts and animals, ſenſible of its approach, are ſeen running over the fields, to ſeek for ſhelter. Nothing can be more terrible than its violence when it begins. The houſes in thoſe countries, which are made of timber, the better to reſiſt its fury, bend to the blaſt like oſiers, and again recover their rectitude. The ſun, which, but a moment before, blazed with meridian ſplendor, is totally ſhut out; and a midnight darkneſs prevails, except that the air is inceſſantly illuminated with gleams of lightning, by which one can eaſily ſee to read. The rain falls, at the ſame time, in torrents; and its deſcent has been reſembled to what pours from the ſpouts of our houſes after a violent ſhower. Theſe hurricanes are not leſs offenſive to the ſenſe of ſmelling alſo; and never come without leaving the moſt noiſome ſtench behind them. If the ſeamen alſo lay by their wet cloaths, for twenty-four hours, they are all found ſwarming with little white maggots, that were brought with the hurricane. Our firſt mariners, when they viſited thoſe regions, were ignorant of its effects, and the ſigns of its approach; their ſhips, therefore, were daſhed to the bottom at the firſt onſet; and numberleſs were the wrecks which the hurricane occaſioned. But, at preſent, being fore-warned of its approach, they ſtrip their maſts of all their ſails, and thus patiently abide its fury. Theſe hurricanes are common in all the tropical climates. On the coaſts of Guinea they have frequently three or four in a day, that thus ſhut out the heavens for a little ſpace; and when paſt leave all again in former ſplendor. They chiefly prevail, on that coaſt, in the intervals of the trade-winds; the approach of which clears the air of its meteors, and gives theſe mortal ſhowers that little degree of wholeſomeneſs, which they poſſeſs. They chiefly obtain there during the months of April and May; they are known at Loango, from January to April; on the oppoſite coaſt of Africa, the hurricane ſeaſon begins at May; and, in general, whenever a trade-wind begins to ceaſe, theſe irregular tempeſts are found to exert their fury.

All this is terrible; but there is a tempeſt, known in thoſe climates, more formidable than any we have hitherto been deſcribing, which is called, by the Spaniards, a Tornado. As the former was ſeen arriving from one part of the heavens, and making a line of deſtruction; ſo the winds in this ſeem to blow from every quarter, and ſettle upon one deſtined place, with ſuch fury, that nothing can reſiſt their vehemence. When they have all met, in their central ſpot, then the whirlwind begins with circular rapidity. The ſphere every moment widens as it continues to turn, and catches every object that lies within its attraction. This, alſo, like the former, is preceded by a flattering calm; the air is every where huſhed; and the ſea is as ſmooth as poliſhed glaſs: however, as its effects are more dreadful than thoſe of the ordinary hurricane, the mariner tries all the power of his ſkill to avoid it; which, if he fails of doing, there is the greateſt danger of his going to the bottom. All along the coaſts of Guinea, beginning about two degrees north of the line, and ſo downward, lengthwiſe, for about a thouſand miles, and as many broad, the ocean is unnavigable, upon account of theſe tornados. In this torpid region there reigns unceaſing tornados, or continual calms; among which, whatever ſhip is ſo unhappy as to fall, is totally deprived of all power of eſcaping. In this dreadful repoſe of all the elements, the ſolitary veſſel is obliged to continue, without a ſingle breeze to aſſiſt the mariner's wiſhes, except thoſe whirlwinds, which only ſerve to increaſe his calamity. At preſent, therefore, this part of the ocean is totally avoided; and, although there may be much gold along the coaſts of that part of Africa, to tempt avarice, yet there is ſomething, much more dreadful than the fabled dragon of antiquity, to guard the treaſure. As the internal parts of that country are totally unknown to travellers, from their burning ſand and extenſive deſarts, ſo here we find a vaſt tract of ocean, lying off its ſhores, equally unviſited by the mariner.

But of all theſe terrible tempeſts that deform the face of Nature, and repreſs human preſumption, the ſandy tempeſts of Arabia and Africa, are the moſt terrible, and ſtrike the imagination moſt ſtrongly. To conceive a proper idea of theſe, we are by no means to ſuppoſe them reſembling thoſe whirlwinds of duſt that we ſometimes ſee ſcattering in our air, and ſprinkling their contents upon our roads or meadows. The ſand-ſtorm of Africa exhibits a very different appearance. As the ſand of which the whirlwind is compoſed is exceſſively fine, and almoſt reſembles the parts of water, its motion entirely reſembles that of a fluid, and the whole plain ſeems to float onward, like a ſlow inundation. The body of ſand thus rolling, is deep enough to bury houſes and palaces in its boſom; travellers who are croſſing thoſe extenſive deſarts, perceive its approach at a diſtance, and, in general, have time to avoid it, or turn out of its way, as it generally extends but to a moderate breadth. However,

ever, when it is extremely rapid, or very extenſive, as ſometimes is the caſe, no ſwiftneſs, no art, can avail; nothing then remains, but to meet death with fortitude, and ſubmit to be buried alive with reſignation.

It is happy for us of Britain, that we have no ſuch calamity to fear; for, from this, even ſome parts of Europe are not entirely free. We have an account given us, in the Hiſtory of the French Academy, of a miſerable town in France, that is conſtantly in danger of being buried under a ſimilar inundation. "In the neighbourhood of St. Paul de Leon, in Lower Brittany, there lies a tract of country along the ſea-ſide, which before the year 1666 was inhabited, but now lies deſerted, by reaſon of the ſands which cover it, to the height of twenty feet; and which every year advance more and more in-land, and gain ground continually. From the time mentioned above, the ſand has buried more than ſix leagues of the country inward; and it is now but half a league from the town of St. Paul; ſo that, in all appearance, the inhabitants muſt be obliged to abandon it entirely. In the country that has been overwhelmed, there are ſtill to be ſeen the tops of ſome ſteeples peeping through the ſand, and many chimnies that ſtill remain above this ſandy ocean. The inhabitants, however, had ſufficient time to eſcape; but being deprived of their little all, they had no other reſource but begging for their ſubſiſtence. This calamity chiefly owes its advancement to a north, or an eaſt wind, raiſing the ſand, which is extremely fine, in ſuch great quantities, and with ſuch velocity, that M. Deſlands, who gave the account, ſays, that while he was walking near the place, during a moderate breeze of wind, he was obliged, from time to time, to ſhake the ſand from his cloaths and hat, on which it was lodged in great quantities, and made them too heavy to be eaſily borne. Still further, when the wind was violent, it drove the ſand acroſs a little arm of the ſea, into the town of Roſcoff, and covered the ſtreets of that place two feet deep; ſo that they have been obliged to carry it off in carts. It may alſo be obſerved, that there are ſeveral particles of iron mixed with the ſand, which are readily affected by the loadſtone. The part of the coaſt that furniſhes theſe ſands, is a tract of about four leagues in length; and is upon a level with the ſea at high-water. The ſhore lies in ſuch a manner as to leave its ſands ſubject only to the north and eaſt winds, that bear them farther up the ſhore. It is eaſy to conceive how the ſame ſand that has at one time been borne a ſhort way in land, may, by ſome ſucceeding and ſtronger blaſt, be carried up much higher; and thus the whole may continue advancing forward, deluging the plain, and totally deſtroying its fertility. At the ſame time, the ſea, from whence this deluge of ſand proceeds, may furniſh it in inexhauſtible quantities. This unhappy country, thus overwhelmed in ſo ſingular a manner, may well juſtify what the antients and the moderns have reported concerning thoſe tempeſts of ſand in Africa, that are ſaid to deſtroy villages, and even armies in their boſom."

CHAP. XXI.

Of METEORS, and ſuch Appearances as reſult from a Combination of the Elements.

IN proportion as the ſubſtances of nature are more compounded and combined, their appearances become more inexplicable and amazing. The properties of water have been very nearly aſcertained. Many of the qualities of air, earth, and fire, have been diſcovered, and eſtimated; but when theſe come to be united by Nature, they often produce a reſult which no artificial combinations can imitate: and we ſtand ſurpriſed, that although we are poſſeſſed of all thoſe ſubſtances which Nature makes uſe of, ſhe ſhews herſelf a much more various operator than the moſt ſkilful chemiſt ever appeared to be. Every cloud that moves, and every ſhower that falls, ſerves to mortify the philoſopher's pride, and to ſhew him hidden qualities in air and water, that he finds it difficult to explain. Dews, hail, ſnow, and thunder, are not leſs difficult for being more common. Indeed, when we reflect on the manner in which Nature performs any one of theſe operations, our wonder increaſes. To ſee water, which is heavier than air, riſing in air, and then falling in a form ſo very different from that in which it roſe; to ſee the ſame fluid at one time deſcending in the form of hail, at another in that of ſnow; to ſee two clouds, by daſhing againſt each other, producing an electrical fire, which no watery compoſition that we know of can effect—theſe ſerve ſufficiently to excite our wonder; and ſtill the more, in proportion as the objects are ever preſſing on our curioſity. Much, however, has been written concerning the manner in which nature operates in theſe productions; as nothing is ſo ungrateful to mankind as hopeleſs ignorance.

And firſt, with regard to the manner in which water evaporates, and riſes to form clouds, much has been advanced, and many theories deviſed. All water, ſay ſome, has a quantity of air mixed with it; and the heat of the ſun darting down, diſengages the particles of this air from the groſſer fluid: the ſun's rays being reflected back from the water, carry back with them thoſe bubbles of air and water which, being lighter than the condenſed air, will aſcend till they meet with a more rarefied air; and they will then ſtand ſuſpended. Experience, however, proves nothing of all this. Particles of air or fire, are not thus known to aſcend with a thin coat of water; and, in fact, we know that the little particles of ſteam are ſolid drops of water. But beſides this, water is known to evaporate more powerfully in the ſevereſt froſt, than when the air is moderately warm. Doctor Hamilton, therefore, of the univerſity of Dublin, rejecting this theory, has endeavoured to eſtabliſh another. According to him, as aqua fortis is a menſtruum that diſſolves iron, and keeps it mixed in the fluid; as aqua regia is a menſtruum that diſſolves gold; or as water diſſolves ſalts to a certain quantity; ſo air is a menſtruum that corrodes and diſſolves a certain quantity of water, and keeps it ſuſpended above. But however ingenious this may be, it can hardly be admitted; as we know, by Mariotte's experiment, that if water and air be encloſed together, inſtead of the air's acting as a menſtruum upon the water, the water will act as a menſtruum upon the air, and take it all up. We know alſo, that of two bodies, that which is moſt fluid and penetrating, is moſt likely to be the menſtruum of the other; but water is more fluid and penetrating than air, and, therefore, the moſt likely of the two to be the menſtruum. We know that all bodies are more ſpeedily acted upon, the more their parts are brought into contact with the menſtruum that diſſolves them: but water, incloſed with compreſt air, is not the more diminiſhed thereby. In ſhort, we know, that cold, which diminiſhes the force of other menſtruums, is often found to promote evaporation. In this variety of opinion, and uncertainty of conjecture, we cannot avoid thinking that a theory of evaporation may be formed upon very ſimple and obvious principles, and embarraſſed with very few objections.

We know that a repelling power prevails in nature, not leſs than an attractive one. This repulſion prevails ſtrongly between the body of fire and

that of water. If the end of a red hot bar of iron be plunged into a veſſel of water, the fluid riſes, and large drops of it fly up in all manner of directions, every part bubbling and ſteaming until the iron be cold. Why may we not, for a moment, compare the rays of the ſun, darted directly upon the ſurface of the water, to ſo many bars of red hot iron; each bar, indeed, infinitely ſmall; but not the leſs powerful? In this caſe, wherever a ray of fire darts, the water, from its repulſive quality, will be driven on all ſides; and, of conſequence, as in the caſe of the bar of iron, a part of it will riſe. The parts thus riſing, however, will be extremely ſmall; as the ray that darts is extremely ſo. The aſſemblage of the rays darting upon the water in this manner, will cauſe it to riſe in a light thin ſteam above the ſurface; and as the parts of this ſteam are extremely minute, they will be lighter than air, and, conſequently, float upon it. There is no need for ſuppoſing them bubbles of water, filled with fire; for any ſubſtance, even gold itſelf, will float on air, if its parts be made ſmall enough; or, in other words, if its ſurface be ſufficiently increaſed. This water, thus diſengaged from the geral maſs, will be ſtill farther attenuated and broken by the reflected rays, and conſequently more adapted for aſcending.

From this plain account, every appearance in evaporation may be eaſily deduced. The quantity of heat increaſes evaporation, becauſe it raiſes a greater quantity of ſteam. The quantity of wind increaſes evaporation; for, by waving the ſurface of the water, it thus expoſes a greater ſurface to the evaporating rays. A dry froſt, in ſome meaſure, aſſiſts the quantity of evaporation; as the quantity of rays are found to be no way diminiſhed thereby. Moiſt weather alone prevents evaporation; for the rays being abſorbed, refracted, and broken, by the intervening moiſture, before they arrive at the ſurface, cannot produce the effect; and the vapour will riſe in a ſmall proportion.

Thus far we have accounted for the aſcent of vapours; but to account for their falling again, is attended with rather more difficulty. We have already obſerved, that the particles of vapour, diſengaged from the ſurface of the water, will be broken and attenuated in their aſcent, by the reflected, and even the direct rays, that happen to ſtrike upon their minute ſurfaces. They will, therefore, continue to aſcend, till they riſe above the operation of the reflected rays, which reaches but to a certain height above the ſurface of the earth. Being arrived at this region, which is cold for want of reflected heat, they will be condenſed, and ſuſpended in the form of clouds. Some vapours that aſcend to great heights, will be frozen into ſnow; others, that are condenſed lower down, will put on the appearance of a miſt, which we find the clouds to be, when we aſcend among them, as they hang along the ſides of a mountain. Theſe clouds of ſnow and rain, being blown about by winds, are either entirely ſcattered and diſperſed above, or they are ſtill more condenſed by motion, like a ſnow-ball, that grows more large and ſolid as it continues to roll. At laſt, therefore, they will become too weighty for the air which firſt raiſed them, to ſuſtain; and they will deſcend, with their exceſs of weight, either in ſnow or rain. But as they will fall precipitately, when they begin to deſcend, the air, in ſome meaſure, will reſiſt the falling; for, as the deſcending fluid gathers velocity in its precipitation, the air will increaſe its reſiſtance to it, and the water will, therefore, be thus broken into rain; as we ſee, that water which falls from the tops of houſes, though it begins in a ſpout, ſeparates into drops before it has got to the bottom. Were it not for this happy interpoſition of the air, between us and the water falling from a conſiderable height above us, a drop of rain might fall with dangerous force, and an hail-ſtone might ſtrike us with fatal rapidity.

In this manner, evaporation is produced by day; but when the ſun goes down, a part of that vapour which his rays had excited, being no longer broken, and attenuated by the reflecting rays, it will become heavier than the air, even before it has reached the clouds; and it will, therefore, fall back in dews, which differ only from rain in deſcending before they have had time to condenſe into a viſible form.

Hail, the Carteſians ſay, is a frozen cloud, half melted, and frozen again in its deſcent. An hoar-froſt is but a frozen dew. Lightning we know to be an electrical flaſh, produced by the oppoſition of two clouds: and thunder to be the ſound proceeding from the ſame, continued by an echo reverberated among them. It would be to very little purpoſe, to attempt explaining exactly how theſe wonders are effected: we have as yet but little inſight into the manner in which theſe meteors are found to operate upon each other; and, therefore, we muſt be contented with a detail rather of their effects than their cauſes.

In our own gentle climate, where Nature wears the mildeſt and kindeſt aſpect, every meteor ſeems to befriend us. With us, rains fall in refreſhing ſhowers, to enliven our fields, and to paint the landſcape with a more vivid beauty. Snows cover the earth, to preſerve its tender vegetables from the inclemency of the departing winter. The dews deſcend with ſuch an imperceptible fall as no way injures the conſtitution. Even thunder is ſeldom injurious; and it is often wiſhed by the huſbandman, to clear the air, and to kill numberleſs inſects that are noxious to vegetation. Hail is the moſt injurious meteor that is known in our climate; but it ſeldom viſits us with violence, and then its fury is but tranſient.

One of the moſt dreadful ſtorms we hear of, was that of Hertfordſhire, in the year 1697. It began by thunder and lightning, which continued for ſome hours, when ſuddenly a black cloud came forward, againſt the wind, and marked its paſſage with devaſtation. The hail-ſtones which it poured down, being meaſured, were found to be many of them fourteen inches round, conſequently, as large a bowling-green ball. Wherever it came, every plantation fell before it; it tore up the ground, ſplit great oaks, and other trees, without number; the fields of rye were cut down, as if levelled with a ſcythe; wheat, oats, and barley, ſuffered the ſame damage. The inhabitants found but a precarious ſhelter, even in their houſes, their tiles and windows being broke by the violence of the hail-ſtones, which, by the force with which they came, ſeemed to have deſcended from a great height. The birds, in this univerſal wreck, vainly tried to eſcape by flight; pigeons, crows, rooks, and many more of the ſmaller and feebler kinds, were brought down. An unhappy young man, who had not time to take ſhelter, was killed; one of his eyes was ſtruck out of his head, and his body was all over black with the bruiſes: another had juſt time to eſcape, but not without the moſt imminent danger, his body being bruiſed all over. But what is moſt extraordinary, all this fell within the compaſs of a mile.

Mezeray, in his Hiſtory of France, tells us of a ſhower of hail much more terrible, which happened in the year 1510, when the French monarch invaded Italy. There was, for a time, an horrid darkneſs, thicker than that of midnight, which continued till the terrors of mankind were changed to ſtill more terrible objects, by thunder and lightning breaking the gloom, and bringing on ſuch a ſhower of hail, as no hiſtory of human calamities could

could equal. These hail-stones were of a bluish colour; and some of them weighed not less than an hundred pounds. A noisome vapour of sulphur attended the storm. All the birds and beasts of the country were entirely destroyed. Numbers of the human race suffered the same fate. But what is still more extraordinary, the fishes found no protection from their native element; but were equal sufferers in the general calamity.

These, however, are terrors that are seldom exerted in our mild climates. They only serve to mark the page of history with wonder; and stand as admonitions to mankind, of the various stores of punishment in the hands of the Deity, which his power can treasure up, and his mercy can suspend.

In the temperate zones, therefore, meteors are rarely found thus terrible; but between the tropic, and near the poles, they assume very dreadful and various appearances. In those inclement regions, where cold and heat exert their chief power, meteors seem peculiarly to have fixed their residence. They are seen there in a thousand terrifying forms, astonishing to Europeans, yet disregarded by the natives, from their frequency. The wonders of air, fire, and water, are there combined, to produce the most tremendous effects; and to sport with the labours and apprehensions of mankind. Lightnings, that flash without noise; hurricanes, that tear up the earth; clouds, that all at once pour down their contents, and produce an instant deluge; mock suns, northern lights, that illuminate half the hemisphere; circular rainbows; halos; fleeting balls of fire; clouds, reflecting back the images of things on earth, like mirrors; and water-spouts, that burst from the sea, to join with the mists, that hang immediately above them. These are but a part of the phænomena that are common in those countries; and from many of which, our own climate is, in a great measure, exempted.

The meteors of the torrid zone are different from those that are found near the polar circles: and it may readily be supposed, that in those countries where the sun exerts the greatest force in raising vapours of all kinds, there should be the greatest quantity of meteors. Upon the approach of the winter months, as they are called, under the line, which usually begin about May, the sky, from a fiery brightness, begins to be overcast, and the whole horizon seems wrapt in a muddy cloud. Mists and vapours still continue to rise; and the air, which so lately before was clear and elastic, now becomes humid, obscure, and stifling: the fogs become so thick, that the light of the sun seems in a manner excluded; nor would its presence be known, but for the intense and suffocating heat of its beams, which dart through the gloom, and, instead of dissipating, only serve to increase the mist. After this preparation, there follows an almost continual succession of thunder, rain, and tempests. During this dreadful season, the streets of cities flow, like rivers; and the whole country wears the appearance of an ocean. The inhabitants often make use of this opportunity to lay in a stock of fresh water, for the rest of the year; as the same cause which pours down the deluge at one season, denies the kindly shower at another. The thunder which attends the fall of these rains, is much more terrible than that we are generally acquainted with. With us, the flash is seen at some distance, and the noise shortly after ensues; our thunder generally rolls on one quarter of the sky, and one stroke pursues another. But here it is otherwise; the whole sky seems illuminated with unremitted flashes of lightning; every part of the air seems productive of its own thunders; and every cloud produces it own shock. The strokes come so thick, that the inhabitants can scarce mark the intervals; but all is one unremitted roar of elementary

confusion. It should seem, however, that the lightning of those countries is not so fatal, or so dangerous, as with us; since, in this case, the torrid zone would be uninhabitable.

When these terrors have ceased, with which, however, the natives are familiar, meteors of another kind begin to make their appearance. The intense beams of the sun, darting upon stagnant waters, that generally cover the surface of the country, raise vapours of various kinds. Floating bodies of fire, which assume different names, rather from their accidental forms, than from any real difference between them, are seen without surprize. The draco volans, or flying dragon, as it is called; the ignis fatuus, or wandering fire; the fires of St. Helmo, or the mariner's light, are every where frequent; and of these we have numberless descriptions. "As I was riding in Jamaica," says Mr. Barbham, "one morning from my habitation, situated about three miles north-west from Jago de la Vega, I saw a ball of fire, appearing to me of the bigness of a bomb, swiftly falling down with a great blaze. At first I thought it fell into the town; but when I came nearer, I saw many people gathered together, a little to the southward, in the Savannah, to whom I rode up, to enquire the cause of their meeting: they were admiring, as I found, the ground's being strangely broke up and ploughed by a ball of fire; which, as they said, fell down there. I observed there were many holes in the ground; one in the middle of the bigness of a man's head, and five or six smaller round about it, of the bigness of one's fist, and so deep as not to be fathomed by such implements as were at hand. It was observed, also, that all the green herbage was burnt up, near the holes; and there continued a strong smell of sulphur near the place, for some time after."

Ulloa gives an account of one of a similar kind, at Quito. "About nine at night," says he, "a globe of fire appeared to rise from the side of the mountain Pichinca, and so large, that it spread a light over all the part of the city facing that mountain. The house where I lodged looking that way, I was surprised with an extraordinary light, darting through the crevices of the window-shutters. On this appearance, and the bustle of the people in the street, I hastened to the window, and came time enough to see it, in the middle of its career; which continued from west to south, till I lost sight of it, being intercepted by a mountain, that lay between me and it. It was round; and its apparent diameter about a foot. I observed it to rise from the sides of Pichinca; although, to judge from its course, it was behind that mountain where this congeries of inflammable matter was kindled. In the first half of its visible course it emitted a prodigious effulgence, then it began gradually to grow dim; so that, upon its disappearing behind the intervening mountain, its light was very faint."

Meteors, of this kind, are very frequently seen between the tropics; but they sometimes, also, visit the more temperate regions of Europe. We have the description of a very extraordinary one, given us by Montanari, that serves to shew to what great heights, in our atmosphere, these vapours are found to ascend. In the year 1676, a great globe of fire was seen at Bononia, in Italy, about three quarters of an hour after sun-set. It passed westward, with a most rapid course, and at the rate of not less than a hundred and sixty miles in a minute, which is much swifter than the force of a cannon-ball, and, at last, stood over the Adriatic sea. In its course it crossed over all Italy; and, by computation, it could not have been less than thirty-eight miles above the surface of the earth. In the whole line of its course, wherever it approached, the inhabitants below could distinctly hear it, with a hissing noise,

resembling that of a fire-work. Having passed away to sea, towards Corsica, it was heard, to last, to go off with a most violent explosion, much louder than that of a cannon; and, immediately after, another noise was heard, like the rattling of a great cart upon a stony pavement; which was, probably, nothing more than the echo of the former sound. Its magnitude, when at Bononia, appeared twice as long as the moon, one way; and as broad the other; so that, considering its height, it could not have been less than a mile long, and half a mile broad. From the height at which this was seen, and there being no volcano, on that quarter of the world, from whence it came, it is more than probable that this terrible globe was kindled on some part of the contrary side of the globe, in those regions of vapours, which we have been just describing; and thus rising above the air, and passing, in a course opposite to that of the earth's motion, in this manner it acquired its amazing rapidity.

To these meteors, common enough southward, we will add one more of a very uncommon kind, which was seen by Ulloa, at Quito, in Peru; the beauty of which will, in some measure, serve to relieve us, after the description of those hideous ones preceding. "At day-break," says he, "the whole mountain of Pambamarca, where we then resided, was encompassed with very thick clouds, which the rising of the sun dispersed so far, as to leave only some vapours, too fine to be seen. On the side opposite to the rising sun, and about ten fathoms distant from the place where we were standing, we saw, as in a looking glass, each his own image; the head being, as it were, the center of three circular rainbows, one without the other, and just near enough to each other as that the colours of the internal verged upon those more external; while round all was a circle of white, but with a greater space between. In this manner these circles were erected, like a mirror, before us; and as we moved, they moved, in disposition and order. But, what is most remarkable, though we were six in number, every one saw the phænomenon, with regard to himself, and not that relating to others. The diameter of the arches gradually altered, as the sun rose above the horizon; and the whole, after continuing a long time insensibly faded away. In the beginning, the diameter of the inward iris, taken from its last colour, was about five degrees and a half; and that of the white arch, which surrounded the rest, was not less than sixty-seven degrees. At the beginning of the phænomenon, the arches seemed of an oval or eliptical figure, like the disk of the sun; and afterwards became perfectly circular. Each of these was of a red colour, bordered with an orange; and the last bordered by a bright yellow, which altered into a straw colour, and this turned to a green; but, in all, the external colour remained red." Such is the description of one of the most beautiful illusions that has been ever seen in nature. This alone seems to have combined all the splendours of optics in one view. To understand the manner, therefore, how this phænomenon was produced, would require a perfect knowledge of optics; which it is not our present province to enter upon. It will be sufficient, therefore, only to observe, that all these appearances arise from the density of the cloud, together with its uncommon and peculiar situation, with respect to the spectator and the sun. It may be observed, that but one of these three rainbows was real, the rest being only reflections thereof. It may also be observed, that whenever the spectator stands between the sun and a cloud of falling rain, a rainbow is seen, which is nothing more than the reflection of the different coloured rays of light from the bosom of the cloud. If, for instance, we take a glass globe, filled with water, and hang it up before us, opposite the sun, in many situations, it will appear transparent; but if it is raised higher, or sideways, to an angle of forty-five degrees, it will at first appear red; altered a very little higher, yellow; then green, then blue, then violet colour; in short, it will assume successively all the colours of the rainbow; but, if raised higher, still it will become transparent again. A falling shower may be considered as an infinite number of these little transparent globes, assuming different colours, by being placed at the proper heights. The rest of the shower will appear transparent, and no part of it will seem coloured; but such as are at angles of forty-five degrees from the eye, forty-five degrees upward, forty-five degrees on each side, and forty-five degrees downward, did not the plain of the earth prevent us. We, therefore, see only an arch of the rainbow, the lower part being cut off from our sight by the earth's interposition. However, upon the tops of very high mountains, circular rainbows are seen, because we can see to an angle of forty-five degrees downward, as well as upward, or sideways, and therefore we take in the rainbow's complete circle.

In those forlorn regions, round the poles, the meteors though of another kind, are not less numerous and alarming. When the winter begins, and the cold prepares to set in, the same misty appearance which is produced in the southern climates by the heat, is there produced by the contrary extreme. The sea smokes like an oven, and a fog arises, which mariners call the frost smoke. This cutting mist, commonly raises blisters on several parts of the body; and, as soon as it is wafted to some colder part of the atmosphere, it freezes to little icy particles, which are driven by the wind, and create such an intense cold on land, that the limbs of the inhabitants are sometimes frozen, and drop off.

There also, halos, or luminous circles round the moon, are oftener seen than in any other part of the earth, being formed by the frost smoke; although the air otherwise seems to be clear. A lunar rainbow also is often seen there, though somewhat different from that which is common with us; as it appears of a pale white, striped with grey. In these countries also the aurora borealis streams, with peculiar lustre, and variety of colours. In Greenland it generally arises in the east, and darts its sportive fires, with variegated beauty, over the whole horizon. Its appearance is almost constant in winter; and, at those seasons when the sun departs, to return no more for half a year, this meteor kindly rises to supply its beams, and affords sufficient light for all the purposes of existence. However, in the very midst of their tedious night, the inhabitants are not entirely forsaken. The tops of the mountains are often seen painted with the red rays of the sun; and the poor Greenlander from thence begins to date his chronology. It would appear whimsical to read a Greenland calendar, in which we might be told, that one of their chiefs, having lived forty days, died, at last, of a good old age; and that his widow continued for half a day to deplore his loss, with great fidelity, before she admitted a second husband.

The meteors of the day, in these countries, are not less extraordinary than those of the night. Mock suns are often reflected upon an opposite cloud; and the ignorant spectator fancies that there are often three or four real suns in the firmament at the same time. In this splendid appearance the real sun is always readily known by its superior brightness, every reflection being seen with diminished splendour. The solar rainbow there is often seen different from ours. Instead of a pleasing variety of colours,

lours; it appears of a pale white, edged with a ſtripe of duſky yellow; the whole being reflected from the boſom of a frozen cloud.

But, of all the meteors which mock the imagination with an appearance of reality, thoſe ſtrange illuſions that are ſeen there, in fine ſerene weather, are the moſt extraordinary and entertaining. "Nothing," ſays Krantz, "ever ſurpriſed me more, than, on a fine warm ſummer's day, to perceive the iſlands that lie four leagues weſt of our ſhore, putting on a form quite different from what they are known to have. As I ſtood gazing upon them, they appeared, at firſt, infinitely greater than what they naturally are; and ſeemed as if I viewed them through a large magnifying glaſs. They were not thus only made larger, but brought nearer to me. I plainly deſcried every ſtone upon the land, and all the furrows filled with ice, as if I ſtood cloſe by. When this illuſion had laſted for a while, the proſpect ſeemed to break up, and a new ſcene of wonder to preſent itſelf. The iſlands ſeemed to travel to the ſhore, and repreſented a wood, or a tall cut hedge. The ſcene then ſhifted, and ſhewed the appearance of all ſorts of curious figures; as ſhips with ſails, ſtreamers and flags; antique elevated caſtles, with decayed turrets; and a thouſand forms, for which fancy found a reſemblance in nature. When the eye had been ſatisfied with gazing, the whole groupe of riches ſeemed to riſe in air, and at length vaniſh into nothing. At ſuch times the weather is quite ſerene and clear; but compreſt with ſuch ſubtle vapours, as it is in very hot weather; and theſe appearing between the eye and the object, give it all that variety of appearances which glaſſes of different refrangibilities would have done." Mr. Krantz obſerves, that commonly a couple of hours afterwards, a gentle weſt wind and a viſible miſt follows, which puts an end to this *luſus naturæ*.

It were eaſy to ſwell this catalogue of meteors with the names of many others, both in our own climate and in other parts of the world. Such as falling ſtars, which are thought to be no more than unctuous vapours, raiſed from the earth to ſmall heights, and continuing to ſhine till that matter which firſt raiſed and ſupported them, being burnt out, they fall back again to the earth, with extinguiſhed flame. Burning ſpears, which are a peculiar kind of aurora borealis; bloody rains, which are ſaid to be the excrements of an inſect, that at that time has been raiſed into the air. Showers of ſtones, fiſhes, and ivy-berries, at firſt, no doubt, raiſed into the air by tempeſts in one country, and falling at ſome conſiderable diſtance, in the manner of rain, to aſtoniſh another. But omitting theſe, of which we know little more than what is thus briefly mentioned, we will give a deſcription of a water-ſpout; a moſt ſurpriſing phænomenon; not leſs dreadful to mariners, than aſtoniſhing to the obſervers of nature.

Theſe ſpouts are ſeen very commonly in the tropical ſeas, and ſometimes in our own. Thoſe ſeen by Tournefort, in the Mediterranean, he has deſcribed as follows. "The firſt of theſe," ſays this great botaniſt, "that we ſaw, was about a muſket-ſhot from our ſhip. There we perceived the water began to boil, and to riſe about a foot above its level. The water was agitated and whitiſh; and above its ſurface there ſeemed to ſtand a ſmoke, ſuch as might be imagined to come from wet ſtraw before it begins to blaze. It made a ſort of a murmuring ſound, like that of a torrent, heard at a diſtance, mixed, at the ſame time, with an hiſſing noiſe, like that of a ſerpent: ſhortly after we perceived a column of this ſmoke riſe up to the clouds, at the ſame time whirling about with great rapidity. It appeared to be as thick as one's finger; and the former ſound ſtill continued. When this diſappeared, after laſting for about eight minutes, upon turning to the oppoſite quarter of the ſky, we perceived another, which began in the manner of the former; preſently after a third appeared in the weſt, and inſtantly beſide it ſtill another ariſe. The moſt diſtant of theſe three could not be above a muſket-ſhot from the ſhip. They all continued like ſo many heaps of wet ſtraw ſet on fire, that continued to ſmoke, and to make the ſame noiſe as before. We ſoon after perceived each, with its reſpective canal, mounting up in the clouds, and ſpreading where it touched; the cloud, like the mouth of a trumpet, making a figure, to expreſs it intelligibly, as if the tail of an animal were pulled at one end by a weight. Theſe canals were of a whitiſh colour, and ſo tinged, as I ſuppoſe, by the water which was contained in them; for, previous to this, they were apparently empty, and of the colour of tranſparent glaſs. Theſe canals were not ſtraight, but bent in ſome parts, and far from being perpendicular, but riſing in their clouds with a very inclined aſcent. But what is very particular; the cloud to which one of them was pointed happening to be driven by the wind, the ſpout ſtill continued to follow its motion, without being broken; and paſſing behind one of the others, the ſpouts croſſed each other, in the form of a St. Andrew's croſs. In the beginning they were all about as thick as one's finger, except at the top, where they were broader, and two of them diſappeared; but ſhortly after, the laſt of the three increaſed conſiderably; and its canal, which was at firſt ſo ſmall, ſoon became as thick as a man's arm, then as his leg, and at laſt thicker than his whole body. We ſaw diſtinctly, through this tranſparent body, the water, which roſe up with a kind of ſpiral motion; and it ſometimes diminiſhed a little of its thickneſs, and again reſumed the ſame; ſometimes widening at top, and ſometimes at bottom; exactly reſembling a gut filled with water, preſſed with the fingers, to make the fluid riſe or fall; and I am well convinced, that this alteration in the ſpout was cauſed by the wind, which preſſed the cloud, and impelled it to give up its contents. After ſome time its bulk was ſo diminiſhed as to be no thicker than a man's arm again; and thus, ſwelling and diminiſhing, it at laſt became very ſmall. In the end, I obſerved the ſea which was raiſed about it to reſume its level by degrees, and the end of the canal that touched it to become as ſmall as if it had been tied round with a cord; and this continued till the light, ſtriking through the cloud, took away the view. I ſtill, however, continued to look, expecting that its parts would join again, as I had before ſeen in one of the others, in which the ſpout was more than once broken, and yet again came together; but I was diſappointed, for the ſpout appeared no more."

Many have been the ſolutions offered for this ſurprizing appearance. Mr. Buffon ſuppoſes the ſpout, here deſcribed, to proceed from the operation of fire, beneath the bed of the ſea; as the waters at the ſurface are thus ſeen agitated. However, the ſolution of Dr. Stuart is not diveſted of probability; who thinks it may be accounted for by ſuction, as in the application of a cupping-glaſs to the ſkin.

Wherever ſpouts of this kind are ſeen they are extremely dreaded by mariners; for if they happen to fall upon a ſhip they moſt commonly daſh it to the bottom. But, if the ſhip be large enough to ſuſtain the deluge, they are at leaſt ſure to deſtroy its ſails and rigging, and render it unfit for ſailing. It is ſaid that veſſels of any force uſually fire their guns at them, loaden with a bar of iron; and, if ſo happy as to ſtrike them, the water is inſtantly ſeen

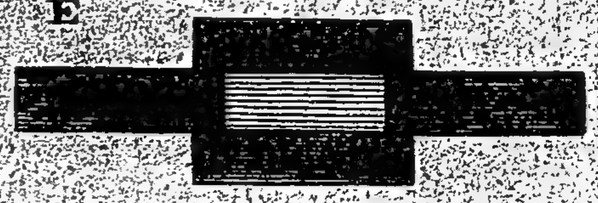
to

VARIOUS OBJECTS IN NATURAL HISTORY.

DEATH WATCH

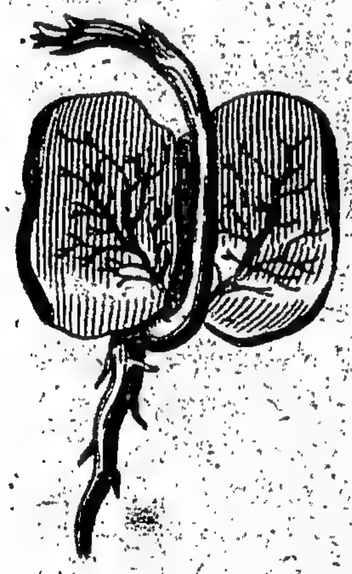
FEATHER

FIBRE

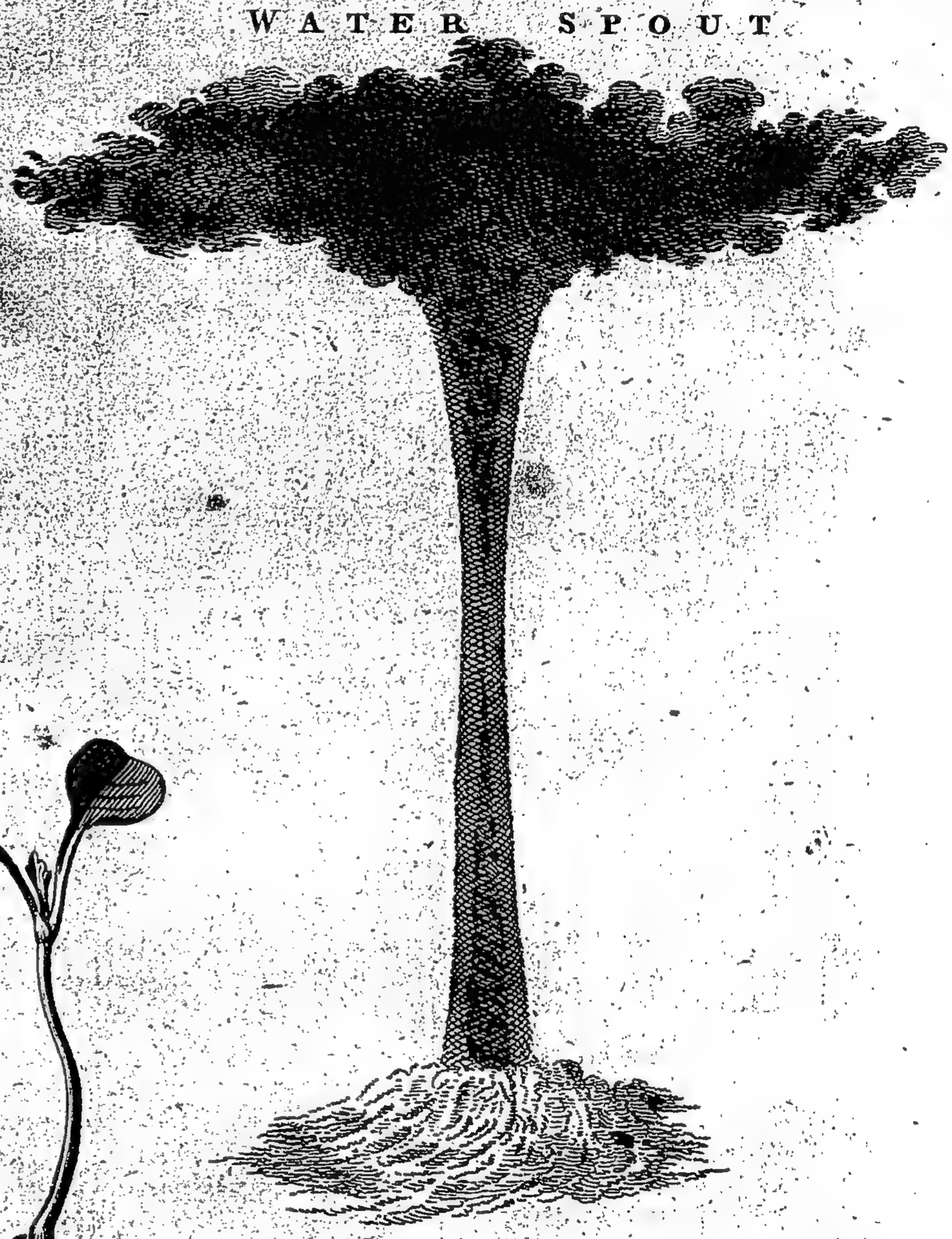


PLANTS

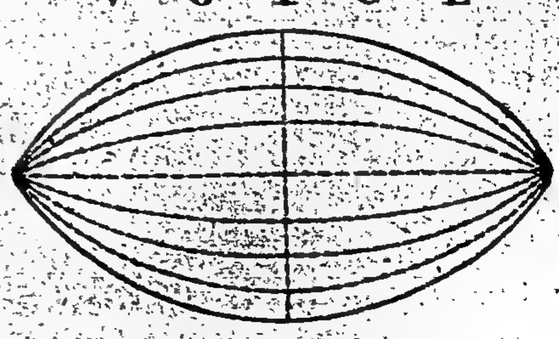
SEED



WATER SPOUT

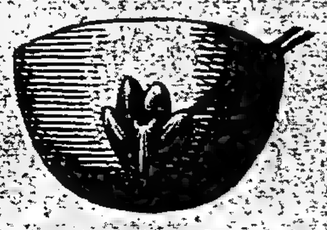


VOICE



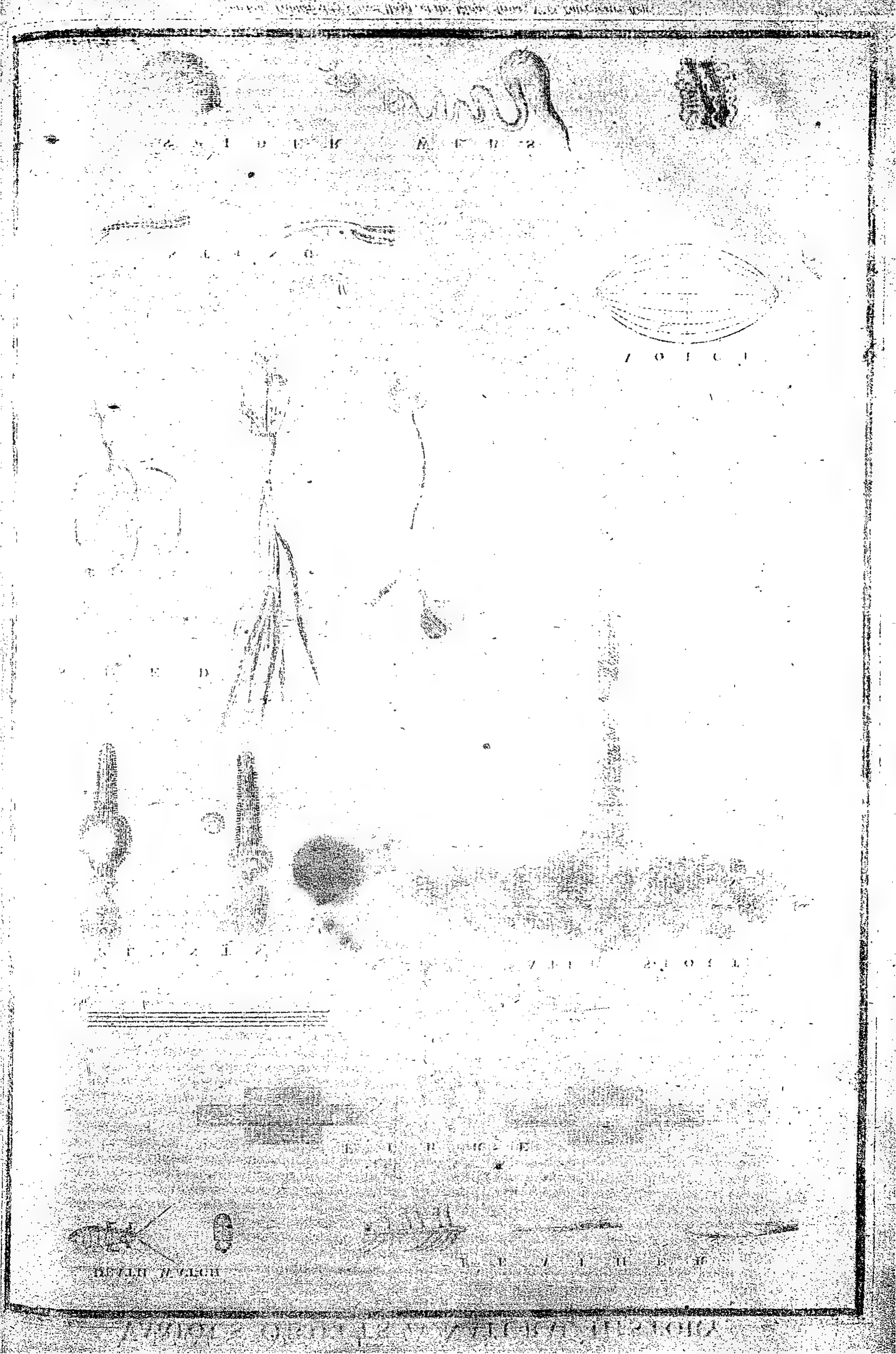
STING

SPIDER WEBS



London, Published by Alex.r Hogg, at the Kings Arms, N.o 16, Paternoster Row.

Lowry sculp



to fall from them, with a dreadful noiſe, though without any further miſchief.

The more the ſky is obſcured with clouds, water-ſpouts, and the phænomena which accompany them, are the more eaſily obſerved.

M. de la Nux thinks, and perhaps with reaſon, that water-ſpouts are nothing but viſcous portions of a cloud driven off by different whirlwinds, i. e. by the whirlings of the ſuperior air ſinking into the maſs of vapours of which the whole cloud is compoſed.

What ſeems to prove that theſe water-ſpouts are compoſed of viſcous parts, is the tenaciouſneſs of their coheſion; for they make inflexions and curvatures in every direction, without breaking. If the matter of water-ſpouts was not viſcous, how can we conceive that they ſhould, without breaking, bend and obey the motion of the winds? If all the parts did not firmly adhere, the wind would diſſipate them, or, at leaſt, make them change their form. But, as the form, both of the large and ſmall water-ſpouts, is uniformly the ſame, this is almoſt a certain indication of the viſcous tenacity of the matter of which they are compoſed.

Thus the baſis of the matter of water-ſpouts is a viſcous ſubſtance contained in the clouds, and every water-ſpout is formed by a whirlwind of air preſſing through the maſs of vapours, and, by blowing up the inferior part of the cloud, pierces it, and deſcends with its covering of viſcous matter. And, as complete water-ſpouts deſcend from the cloud to the ſurface of the ſea, the water muſt boil and whirl at the place to which the end of the water-ſpout is directed; becauſe the air blows from the extremity of the water-ſpout like the tube of a pair of bellows. The effects of this blowing upon the ſea will augment, in proportion as the cylinder approaches the ſurface of the water; and, when the orifice of the tube enlarges, a greater quantity of air is permitted to eſcape, and the agitation of the water is, of courſe, increaſed.

M. de la Nux has ſeen water-ſpouts around the iſle of Bourbon in the months of January, May, June, and October, i. e. in all ſeaſons of the year. He has ſeen them in calm weather, and during the higheſt winds. Theſe phænomena, however, may be ſaid to be rare, and ſeldom appear but upon the ſea; becauſe the viſcoſity of the clouds can only proceed from the bituminous and greaſy particles raiſed, by the heat of the ſun and the winds, from the waters of the ſea, and collected in the clouds near its ſurface. It is for this reaſon that water-ſpouts ſeldom appear on land, where there is not, as on the ſurface of the ſea, a ſufficient quantity of bituminous and oily particles to be exhaled by the action of the ſun. They are ſometimes, however, obſerved on land, and even at great diſtances from the ſea; this effect may be produced, when viſcous clouds have been rapidly driven by a violent wind from the ſea toward the land. M. Grignon, in the month of June 1768, ſaw a well formed water-ſpout in Lorrain near Vauvillier, among the hills which are a continuation of the Voſges. It was about fifty fathoms high. Its form was that of a column, and it communicated with a large thick cloud. It was impelled by one or ſeveral winds, which made the water-ſpout turn rapidly; and it produced lightning and thunder. This water-ſpout continued ſeven or eight minutes only, and broke upon the baſe of the hill, which is from five to ſix hundred feet high.

We are at a loſs whether we ought to reckon theſe ſpouts called typhons, which are ſometimes ſeen at land, of the ſame kind with thoſe ſo often deſcribed by mariners, at ſea, as they ſeem to differ in ſeveral reſpects. That, for inſtance, obſerved at Hatfield, in Yorkſhire, in 1687, as it is deſcribed by a perſon who ſaw it, ſeems rather to have been a whirlwind than a water-ſpout. The ſeaſon in which it appeared was very dry, the weather extremely hot, and the air very cloudy. After the wind had blown for ſome time, with conſiderable force, and condenſed the black clouds one upon another, a great whirling of the air enſued, upon which the center of the clouds, every now and then, darted down, in the ſhape of a thick long black pipe; in which the relator could diſtinctly view a motion, like that of a ſcrew, continually ſcrewing up to itſelf, as it were, whatever it happened to touch. In its progreſs it moved ſlowly over a grove of young trees, which it violently bent, in a circular motion. Going forward to a barn, it in a minute ſtript it of all the thatch, and filled the whole air with the ſame. As it came near the relator, he perceived that its blackneſs proceeded from a gyration of the clouds, by contrary winds, meeting in a point, or a center; and where the greateſt force was exerted, there darting down, like an Archimedes's ſcrew, to ſuck up all that came in its way. Another which he ſaw, ſome time after, was attended with ſtill more terrible effects; levelling, or tearing up great oak trees, catching up the birds in its vortex, and daſhing them againſt the ground. In this manner it proceeded, with an audible whirling noiſe, like that of a mill; and, at length, diſſolved, after having done much miſchief.

But we muſt ſtill continue to ſuſpend our aſſent as to the nature even of theſe land ſpouts; ſince they have been ſometimes found to drop, in a great column of water, at once upon the earth, and produce an inſtant inundation, which could not readily have happened had they been cauſed by the gyration of a whirlwind only. Indeed, every conjecture regarding theſe meteors, ſeems to be entirely unſatisfactory. They ſometimes appear in the calmeſt weather at ſea; and, therefore, theſe are not cauſed by a whirlwind. They are always capped by a cloud: and, therefore, are not likely to proceed from fires at the bottom. They change place; and, therefore, ſuction ſeems impracticable. In ſhort, we ſtill want facts, upon which to build a rational theory; and, inſtead of knowledge, we muſt be contented with admiration. To be well acquainted with the appearances of Nature, even though we are ignorant of their cauſes, often conſtitutes the moſt uſeful wiſdom.

Having thus gone through a particular deſcription of the earth, let us now pauſe for a moment, to contemplate the great picture before us. The univerſe may be conſidered as the palace in which the Deity reſides; and this earth as one of its apartments. In this, all the meaner races of animated nature mechanically obey him; and ſtand ready to execute his commands, without heſitation. Man alone is found refractory; he is the only being endued with a power of contradicting theſe mandates. The Deity was pleaſed to exert ſuperior power in creating him a ſuperior being; a being endued with a choice of good and evil; and capable, in ſome meaſure, of co-operating with his own intentions. Man, therefore, may be conſidered as a limited creature, endued with powers imitative of thoſe reſiding in the Deity. He is thrown into a world that ſtands in need of his help; and has been granted a power of producing harmony from partial confuſion.

If, therefore, we conſider the earth as allotted for our habitation, we ſhall find, that much has been given us to enjoy, and much to amend; that we have ample reaſons for our gratitude, and ſtill more for our induſtry. In thoſe great outlines of nature,

to which art cannot reach, and where our greateſt efforts muſt have been ineffectual, God himſelf has finiſhed theſe with amazing grandeur and beauty. Our beneficent Father has conſidered theſe parts of nature as peculiarly his own; as parts which no creature could have ſkill or ſtrength to amend; and therefore, made them incapable of alteration, or of more perfect regularity. The heavens, and the firmament, ſhew the wiſdom, and the glory of the Workman. Aſtronomers, who are beſt ſkilled in the ſymmetry of ſyſtems, can find nothing there that they can alter for the better. God made theſe perfect, becauſe no ſubordinate being could correct their defects.

When, therefore, we ſurvey nature on this ſide, nothing can be more ſplendid, more correct, or amazing. We there behold a Deity reſiding in the midſt of an univerſe, infinitely extended every way, animating all, and cheering the vacuity with his preſence! We behold an immenſe and ſhapeleſs maſs of matter, formed into worlds by his power, and diſperſed at intervals, to which even the imagination cannot travel! In this great theatre of his glory, a thouſand ſuns, like our own, animate their reſpective ſyſtems, appearing and vaniſhing at divine command. We behold our own bright luminary, fixed in the center of its ſyſtem, wheeling its planets in times proportioned to their diſtances, and at once diſpenſing light, heat, and action. The earth alſo is ſeen with its twofold motion; producing, by the one, the change of ſeaſons; and, by the other, the grateful viciſſitudes of day and night. With what ſilent magnificence is all this performed! with what ſeeming eaſe! The works of art are exerted with interrupted force; and their noiſy progreſs diſcovers the obſtructions they receive: but the earth, with a ſilent ſteady rotation, ſucceſſively preſents every part of its boſom to the ſun; at once imbibing nouriſhment and light from that parent of vegetation and fertility.

But not only proviſions of heat and light are thus ſupplied, but its whole ſurface is covered with a tranſparent atmoſphere, that turns with its motion, and guards it from external injury. The rays of the ſun are thus broken into a genial warmth; and, while the ſurface is aſſiſted, a gentle heat is produced in the bowels of the earth, which contributes to cover it with verdure. Waters alſo are ſupplied in healthful abundance, to ſupport life, and aſſiſt vegetation. Mountains ariſe, to diverſify the proſpect, and give a current to the ſtream. Seas extend from one continent to the other, repleniſhed with animals, that may be turned to human ſupport; and alſo ſerving to enrich the earth with a ſufficiency of vapour. Breezes fly along the ſurface of the fields, to promote health and vegetation. The coolneſs of the evening invites to reſt; and the freſhneſs of the morning renews for labour.

Such are the delights of the habitation that has been aſſigned to man; without any one of theſe he muſt have been wretched; and none of theſe could his own induſtry have ſupplied. But while many of his wants are thus kindly furniſhed, on the one hand, there are numberleſs inconveniencies to excite his induſtry on the other. This habitation, though provided with all the conveniencies of air, paſturage, and water, is but a deſert place, without human cultivation. The loweſt animal finds more conveniencies in the wilds of nature, than he who boaſts himſelf their lord. The whirlwind, the inundation, and all the aſperities of the air, are peculiarly terrible to man, who knows their conſequences, and, at a diſtance, dreads their approach. The earth itſelf, where human art has not pervaded, puts on a frightful gloomy appearance. The foreſts are dark and tangled; the meadows over-grown with rank weeds; and the brooks ſtray without a determined channel. Nature, that has been kind to every lower order of beings, has been quite neglectful with regard to him; to the ſavage unconTriving man the earth is an abode of deſolation, where his ſhelter is inſufficient, and his food precarious.

A world thus furniſhed with advantages on one ſide, and inconveniencies on the other, is the proper abode of reaſon, is the fitteſt to exerciſe the induſtry of a free and a thinking creature. Theſe evils, which art can remedy, and preſcience guard againſt, are a proper call for the exertion of his faculties; and they tend ſtill more to aſſimilate him to his Creator. God beholds with pleaſure, that being which he has made, converting the wretchedneſs of his natural ſituation into a theatre of triumph; bringing all the headlong tribes of nature into ſubjection to his will; and producing that order and uniformity upon earth, of which his own heavenly fabric is ſo bright an example.

A NEW, COMPLETE, and UNIVERSAL BODY, or SYSTEM of NATURAL HISTORY;

Being a Grand, Accurate and Extenſive Diſplay of Animated Nature.

BOOK VII.

Containing the NATURAL HISTORY *of* MAN.

CHAP. I.

Of the Nature of MAN.

HAVING given an account of the Earth in general, and the advantages and inconveniencies with which it abounds, we ſhall now proceed to give the Natural Hiſtory of Man. Though it is ſo much our intereſt to acqure an exact and thorough knowledge of ourſelves, yet we are often leſs acquainted with the human, than with any other exiſtence. Provided by nature with organs, calculated ſolely for our preſervation, we never employ thoſe organs but to receive foreign impreſſions; our only ſtudy is, to acquire a familiarity with external objects, and to exiſt out of ourſelves. Too intent on multiplying the functions of our ſenſes, and on enlarging the external bounds of our being, rarely do we make any uſe of that internal ſenſe which reduces us to our true dimenſions, and which abſtracts from us whatever does not conſtitute a part of ourſelves. It is by an exertion of this ſenſe alone, however, that we can form a proper judgment of ourſelves. But how ſhall it receive its full activity and extent? How ſhall the ſoul, in which it reſides, be diſengaged from all the illuſions of the mind? Having loſt the habit of employing it, it has remained inactive amidſt the tumult of our corporeal ſenſations; it has been, as it were, dried up by the fire of our paſſions; the heart, the mind, the ſenſes, have all co-operated againſt it.

Unalterable in its ſubſtance, and impaſſible by its eſſence, it ſtill, however, continues the ſame. The ſplendor of its light has been overcaſt, but its power has not been diminiſhed. It is leſs luminous; but its guidance is not the leſs certain. Let us then collect thoſe rays, of which we are not yet deprived. The obſcurity with which we are ſurrounded will decreaſe; and though the road may not be every where equally filled with light, we yet ſhall have a torch that will prevent us from going aſtray.

The firſt, and indeed the moſt difficult ſtep, which leads to the knowledge of ourſelves, is, a diſtinct conception of the nature of the two ſubſtances that conſtitute our being. To ſay ſimply, that the one is unextended, immaterial and immortal; and that the other is extended, material and mortal, is only to deny of one thing, what we affirm of another. What knowledge is to be acquired from this mode of negation? Such private expreſſions can exhibit no real and poſitive idea; but to ſay, that we are certain of the exiſtence of the former, and that the exiſtence of the latter is leſs evident; that the ſubſtance of the one is ſimple, indiviſible, and of one form, ſince it only manifeſts itſelf by a ſingle modification, which is thought; that the other is leſs a ſubſtance than a ſubject, capable of receiving different forms, which bear a relation to thoſe of our ſenſes, but all as uncertain, all as variable, as the nature of the organs themſelves: That is to ſay ſomething; it is to aſcribe to each ſuch diſtinct and poſitive properties, as may lead us to an elemental knowledge of both, and to a compariſon between them.

From the ſmalleſt reflection on the origin of our knowledge, it is eaſy, indeed, to perceive, that by compariſon alone, we can acquire it. What is abſolutely incomparable, is utterly incomprehenſible; of this, God is the only inſtance we can adduce; he exceeds all comprehenſion, becauſe he is above all compariſon. But whatever is capable of being compared, whatever we can contemplate in different lights, whatever we can conſider relatively, may always conclude to come within the ſphere of our underſtanding. The more ſubjects of compariſon, the more different views, or particular appearances, we have for examining any object, the more methods there are for obtaining a knowledge of it, and the greater facility there is to combine thoſe ideas which ought to direct our judgment.

The exiſtence of the ſoul is demonſtrated to us; or rather that exiſtence and ourſelves form but one and the ſame thing. To be and to think, are with us identical. This truth is within us, and it is more than intuitive; it is independent of our ſenſes, of our imagination, of our memory, and of all our other relative faculties. The exiſtence of our body, and of other external objects, is held in uncertainty by every unprejudiced reaſoner; for what is that extenſion of length, breadth and depth, which we call our body, and which ſeems to be ſo much our own, but as it relates to our ſenſes? What are even the material organs of thoſe ſenſes, but ſo many conformities with what affects them? And, with regard to our internal ſenſe, our ſoul, has it any thing ſimilar, any thing in common, with the nature of theſe external organs? Does the ſenſation excited in our ſoul by light or ſound, reſemble that tenuous matter, which ſeems to diffuſe light, or even that tremulous undulation, which ſound produces in the air? Our eyes and our ears have every neceſſary conformity with theſe matters, becauſe thoſe organs and matter itſelf, are, in effect, of the ſame nature. The ſenſation, however, which the ſoul experiences, has nothing ſimilar, nothing analogous to it; and is not this a ſufficient proof, that the nature of the ſoul is in reality different from that of matter?

It is a certain truth, then, that the internal ſenſation is altogether different from its cauſe; as alſo, that, if there are things which exiſt without us, they are in themſelves totally different from what we conceive them to be. As the ſenſation therefore, bears no kind of reſemblance to the thing which is the cauſe of it; does it not follow, that what excites our ſenſations is neceſſarily, and of its own nature, quite another thing than we imagine it? The extenſion which we perceive by our eyes, the impenetrability, of which we receive an idea by the touch, all thoſe qualities, whoſe various combinations conſtitute matter, are of a doubtful exiſtence; ſince our inward ſenſation, and what it repreſents to us as extenſion, impenetrability, &c. are no wiſe extended or impenetrable, and have not even the ſmalleſt affinity with thoſe qualities.

If it is obſerved, that the ſoul is often affected with ſenſations, during ſleep, and the abſence of every object; and that theſe ſenſations are ſometimes very different from thoſe, which it has experienced by the preſence of the ſame objects, through the channel of the ſenſes; does it not lead to a belief, that this preſence of objects is not neceſſary to the exiſtence of our ſenſations; and that, of conſequence, our ſoul and we may exiſt ſingly, and independently of thoſe objects? During ſleep, and after death, for example, our body exiſts; it has even all that kind of exiſtence of which it is ſuſceptible, and is the ſame as it was before; yet the ſoul no longer perceives this exiſtence of the body; it has ceaſed to be with regard to us. The queſtion is therefore, whether a thing which can exiſt, and afterwards not exiſt; whether a thing, which affects us in a manner altogether different from what it is, or what it has been, may yet be a reality of indubitable exiſtence.

That ſomething exiſts without us, we may believe, though not with a poſitive aſſurance; whereas of the real exiſtence of every thing within us, we have a certainty. That of our ſoul therefore, is inconteſtible, and that of our body ſeems doubtful; becauſe matter may be only a mode of the ſoul, one of its methods of perception. Our ſoul perceives by this method, when we are awake; it perceives by another method, when we are aſleep; after death, it will perceive by a method far more different ſtill: and whatever is, in the preſent ſtate, the cauſe of its ſenſations, matter in general may well ceaſe to exiſt, with reſpect to it, when all communication with its own body is cut off.

But let us admit this exiſtence of matter; let us, though it is impoſſible to demonſtrate it, adopt the common opinion, and ſay, that it even exiſts as it appears to our ſenſes, by comparing the ſoul with any material object, we ſhall then find differences ſo great, and contrarieties ſo ſtrongly marked, that every doubt will inſtantly vaniſh of its being of a nature totally different, and of an order infinitely ſuperior.

Our ſoul has but one form, which is very ſimple, very general, and very permanent. Thought is this form; otherwiſe than by thought, it is impoſſible for us to perceive the ſoul. This form has nothing in it of diviſion and extenſion, nothing of impenetrability or matter; of conſequence, therefore, our ſoul, the ſubject of this form, is indiviſible, and immaterial. Our body on the contrary, and all other bodies, have many forms. Every one of theſe is compounded, diviſible, variable, periſhable, and has a relation to the different organs, through which we perceive them. Our body, therefore, any things material, having nothing permanent, nothing real, nothing general, by which we may fix our reſearches, and attain a certain knowledge of them. A blind man has no idea of that part of a material object, which repreſents to us the form of bodies; a leper, whoſe ſkin has loſt the ſenſe of feeling, is denied all the ideas which ariſe from the touch; and a deaf man has no knowledge of ſounds. Let theſe three modes of ſenſation be ſucceſſively deſtroyed, in a man whom nature has provided with them, and the ſoul will exiſt in its wonted vigour; its internal functions will ſubſiſt, and thought will ſtill manifeſt itſelf within him. On the other hand, diveſt matter of all its qualities; ſtrip it of colour, of ſtrength, of ſolidity, and of every other property which has any relation to our ſenſes, and the conſequence will be its annihilation. Our ſoul therefore, is unperiſhable, but matter may, and will periſh.

Thus it is with all the other faculties of our ſoul, compared with thoſe of our body, and with the moſt eſſential properties of any kind of matter. As the ſoul wills and commands, ſo the body obeys in every thing within its power. The ſoul forms, at pleaſure, an intimate union with any object: neither diſtance, nor magnitude, nor figure, can obſtruct this union, when the ſoul inclines to it; it is effected, and effected in an inſtant. The body can form no union: whatever touches it too cloſely injures it; it requires a long time in order to approach another body; it every where meets with ſome reſiſtance, with ſome obſtacle; from the ſmalleſt ſhock, its motion ceaſes. Is will then nothing more than a corporeal movement; and is contemplation but a ſimple contact? How could this contact take place upon a remote object, upon an abſtracted ſubject? How could this movement be accompliſhed in an indiviſible inſtant? Is it poſſible to have a conception of motion, without having a conception of ſpace, and of time? Will, therefore, if it be a motion, is not a material one; and if the union of the ſoul to a particular object be a touch, a contact, is not this touch effected at a diſtance; is not this contact a penetration; qualities which are abſolutely oppoſite to thoſe of matter, and which of conſequence cannot belong to an immaterial being?

But we have already dwelt too long on a ſubject, which by many will perhaps be conſidered as foreign to our purpoſe. Ought Conſiderations on the Soul to find a place in a ſyſtem of Natural Hiſtory? Why, after all, retrench from the Natural Hiſtory of Man, the hiſtory of the nobleſt part of his being? Why thus prepoſterouſly debaſe him, and, as it were, force us to conſider him merely as an animal; while in

in reality, he is of a nature ſo different and diſtinguiſhed, ſo ſuperior to that of the brutes, that he who confounds them muſt be immerſed in ignorance as themſeves?

In comparing man with an animal, we find in both a body, an organiſed ſubſtance, ſenſes, fleſh, blood, motion, and a multitude of other reſemblances. But theſe reſemblances, are all external, and not ſufficient to juſtify a deciſion, that the human and the animal natures are ſimilar. In order to form a proper judgment of the nature of each, we ought to have as diſtinct a knowledge of the internal qualities of an animal, as we have of our own. As the knowledge, however, of what paſſes within an animal is impoſſible to be attained; as we know not of what order and kind its ſenſations may be, in relation to thoſe of man; we may judge ſolely from a compariſon of the effects of the natural operations of both.

Let us, then, take a view of theſe effects; and, while we admit of all the particular reſemblances, limit our inveſtigation to the moſt general differences. It will be allowed, that the moſt ſtupid man is able to manage the moſt acute animal: he governs it, and renders it ſubſervient to his purpoſes; and this, not ſo much on account of his ſtrength or ſkill, as of the ſuperiority of his nature, and of his having a rational ſcheme, ſyſtem of action, and method by which he compels the animals to obey him. We do not find, that the ſtrongeſt and moſt expert animals give law to the others, and hold them in ſervitude. The ſtronger, it is true, devour the weaker; but this action implies no more than an urgent neceſſity, or a rage of appetite; a quality very different from that which is capable of producing a ſeries of actions, all tending to the ſame end. Did animals enjoy this faculty, ſhould we not ſee ſome of them aſſume dominion over others, and oblige them to furniſh them with food, to watch over them and to attend them when ſick or wounded? Now, throughout the creation of animals, there is no veſtige of ſuch ſubordination; no appearance that one of them knows, or is ſenſible of, the ſuperiority of his own nature over that of others. It follows, then, that they muſt all be conſidered as of one nature; as alſo, that the nature of man is not only highly ſuperior to that of any animal, but alſo entirely different from it.

Man, by an outward ſign, indicates what paſſes within him; he communicates his ſentiments by ſpeech, which is a ſign common to the whole human ſpecies. The ſavage and the civilized man have the ſame power of utterance; they both ſpeak naturally, and ſpeak ſo as to be underſtood. No animal is endowed with this expreſſion of thought; nor is it a defect owing, as is commonly imagined, to the want of proper organs. Anatomiſts have found the tongue of an ape to be as perfect as that of a man. The ape, therefore, if he had thought, it would have ſpeech; and if its thought had aught analogous to ours, this ſpeech would have an analogy to ours alſo. Suppoſing its thoughts were only the thoughts of an ape, it ſtill would hold ſome kind of diſcourſe with other apes; a circumſtance, of which we ſhould certainly have heard, had it been endowed with the powers of ſpeech. So far, then, is the ape from having any thought like ours, that it has not even any order or ſeries of thoughts of its own. Nothing regular, nothing connected, paſſes within it; for as it expreſſes nothing by combined and ſettled ſigns, ſo it is, of conſequence, void of thought, even in the loweſt degree.

So true it is, that it is from no organical defect, animals are denied the gift of ſpeech, that we know ſeveral ſpecies of them which may be taught to pronounce words, and even repeat ſentences of ſome length. Perhaps, were we to take the trouble to teach them, many others might be found capable of articulating particular ſounds; but to make them conceive the idea which ſuch ſounds denote, is an impracticable taſk. They ſeem to repeat and even to articulate them, merely as an echo, or an artificial machine, would repeat or articulate. It is not in the mechanical powers, or the material organs, but in the intellectual faculty, in thought, that they are deficient.

As all language ſuppoſes a chain of thought, it is on this account that animals have none; for, even allowing ſomething in them which reſembles our firſt apprehenſions, our moſt groſs and mechanical ſenſations, they ſtill will be found incapable of forming that aſſociation of ideas, which can alone produce reflection; and in this, be it remarked, conſiſts the eſſence of thought. To this inability of connecting ideas, it is owing, that they are deſtitute of thought and ſpeech; as alſo, that they neither can invent nor improve any thing. Were they endowed with the power of reflection, even in the moſt ſubordinate degree, they would be capable of making ſome kind of proficiency, and would acquire more induſtry: the modern beaver would build with more art and ſolidity than the ancient; and the bee would daily be adding new improvements to its cell. If we ſuppoſe this cell as perfect already as it can be, we aſcribe to the inſect an intelligence ſuperior to our own; an intelligence whereby it could diſcern at once the laſt degree of perfection to which its work might be carried; while we ourſelves are for ever in the dark as to this degree, and ſtand in need of much reflection, time and practice, in order to perfect even one of our moſt trivial arts.

Whence can ariſe that uniformity we obſerve in all the works of animals? Why does each ſpecies invariably perform the ſame actions in the ſame manner? And why does not one individual perform them better or worſe than another? Can there be a ſtronger proof that their operations are merely the effects of mechaniſm and materiality; evidently as it follows, that if they poſſeſſed the ſmalleſt ſpark of that light which is inherent in us, their works would diſplay variety at leaſt, if they did not diſplay perfection; and that one individual of the ſame ſpecies would, in ſome of its performances, do ſomething a little different from what another had done? But this is far from being the caſe. One plan of action is common to the whole ſpecies, and whoever would attribute a ſoul to animals, muſt of neceſſity, allow but one to each ſpecies. Of this ſoul each individual would be an equal partaker; and as thereby it would be diviſible, it would conſequently be material, and of a nature widely different from ours.

Why, on the other hand, are our productions and performances ſo various and ſo diverſified? Why is a ſervile imitation more troubleſome to us than an original deſign? It is becauſe our ſoul is our own; becauſe it is independent on that of another; becauſe we have nothing in common with our ſpecies, but the ſubſtance of our body; and becauſe, in effect, our reſemblance to animals is confined to the loweſt of our faculties.

Were internal ſenſations annexed to matter, and dependent on the corporeal organs, ſhould we not ſee as remarkable differences in the works of animals of the ſame ſpecies, as in thoſe of men? Would not thoſe which were the moſt happily organized, build their neſts, contrive their cells, or lay their eggs, in a manner more ſolid, more elegant and more commodious? And would not ſome individual, poſſeſſed of a ſuperior genius, take an opportunity to manifeſt that ſuperiority in this very mode? Now nothing of this very kind has ever happened; and therefore the corporeal organs, however perfect or imperfect, have no influence on the nature of

the internal ſenſations. Hence may we conclude, that animals have no ſenſations of this kind; that ſuch ſenſations have no connection with matter, no dependence, in their nature, on the corporeal organs; and that, of conſequence, there muſt be a ſubſtance within us, different from matter, which is at once the ſubject and the cauſe that produces and receives thoſe ſenſations.

But theſe proofs of the immateriality of the ſoul may be carried farther ſtill. In all the works of nature, there are imperceptible gradations maintained. This truth, which in no other inſtance admits of exception, is here expreſsly contradicted; between the faculties of man, and thoſe of the moſt perfect animal, the diſtance is infinite; an evident proof, that man is of a different nature, and that of himſelf he forms a diſtinct claſs, between which and that of animals, there is an immenſe chaſm. If man belonged to the claſs of animals, there would be a certain number of beings in nature leſs perfect than the former, and more perfect than the latter, in order to compleat the gradation of man to the monkey. But this is not the caſe; the tranſition is immediate from the thinking being to the material being; from intellectual power to mechanical force; from order and deſign to blind motion; from reflection to appetite.

To the ingenuous enquirer after truth more than enough has been here advanced, as demonſtrative of the excellency of our nature, and of the immenſe diſtance which the Creator has placed between man and the brute. The former is a rational being, the latter a being devoid of reaſon. And as there is no medium between the poſitive and the negative; as there are no intermediate beings between the rational being, and the being devoid of reaſon; it is evident, that man is of a nature entirely different from that of the animal; that all the reſemblance he bears to it is merely external; and that to judge of him by this reſemblance, is to allow ourſelves to be deceived by appearance, and wilfully to ſhut our eyes againſt that light, by which we ought to diſtinguiſh it from reality.

Having thus conſidered man as to his internal properties, we ſhall now proceed to examine his external ones, and to give the hiſtory of his body. After taking a view of the different ſtages of his life, we ſhall conduct him to the period when he muſt be ſeparated from that body, and then reſign him to the common maſs of matter to which he belongs.

CHAP. II.

The Infancy of MAN.

IN ſurveying the various claſſes of animals, and examining their ſtrength, their beauty, or their ſtructure, we find man poſſeſſes moſt of thoſe advantages united, which the reſt enjoy partially. Infinitely ſuperior to all others in the powers of the underſtanding, he is alſo ſuperior to them in the fitneſs and proportions of his form. He would, indeed, have been one of the moſt miſerable beings upon earth, if with a ſentient mind he was ſo formed as to be incapable of obeying its impulſe; but Nature has otherwiſe provided; as with the moſt extenſive intellects to command, ſhe has furniſhed him with a body the beſt fitted for obedience.

In infancy, however, that mind, and this body, form the moſt helpleſs union in all animated nature; and, if any thing can give us a picture of complete imbecillity, it is a man when juſt come into the world. The infant juſt born ſtands in need of all things, without the power of procuring any. The lower races of animals, upon being produced, are active, vigorous, and capable of ſelf-ſupport; but the infant is obliged to wait in helpleſs expectation; and its cries are its only aid to procure ſubſiſtence.

An infant juſt born may be ſaid to come from one element into another; for from the watery fluid in which it was ſurrounded, it now immerges into air; and its firſt cries ſeem to imply how greatly it regrets the change. How much longer it could have continued in a ſtate of almoſt total inſenſibility, in the womb, is impoſſible to tell; but it is very probable that it could remain there ſome hours more. In order to throw ſome light upon this ſubject, Mr. Buffon ſo placed a pregnant bitch as that her puppies were brought forth in warm water, in which he kept them above half an hour at a time. However, he ſaw no change in the animals, thus newly brought forth; they continued the whole time vigorous; and, during the whole time, it is very probable that the blood circulated through the ſame channels through which it paſſed while they continued in the womb.

Almoſt all animals have their eyes cloſed, for ſome days after being brought into the world. The infant opens them the inſtant of its birth. However, it ſeems to keep them fixed and idle; they want that luſtre which they acquire by degrees; and if they happen to move, it is rather an accidental gaze than an exertion of the act of ſeeing. The light alone ſeems to make the greateſt impreſſion upon them. The eyes of infants are ſometimes found turned to the place where it is ſtrongeſt; and the pupil is ſeen to dilate and diminiſh, as in grown perſons, in proportion to the quantity it receives. But ſtill, the infant is incapable of diſtinguiſhing objects; the ſenſe of ſeeing, like the reſt of the ſenſes, requires an habit before it becomes any way ſerviceable. All the ſenſes muſt be compared with each other, and muſt be made to correct the defects of one another, before they can give juſt information. It is probable, therefore, that if the infant could expreſs its own ſenſations, it would give a very extraordinary deſcription of the illuſions which it ſuffers from them. The ſight might, perhaps, be repreſented as inverting objects, or multiplying them; the hearing, inſtead of conveying one uniform tone, might be ſaid to bring up an interrupted ſucceſſion of noiſes; and the touch apparently would divide one body into as many as there are fingers that graſped it. But all theſe errors are loſt in one common confuſed idea of exiſtence; and it is happy for the infant, that it then can make but very little uſe of its ſenſes, when they could ſerve only to bring it falſe information.

If there be any diſtinct ſenſations, thoſe of pain ſeem to be much more frequent and ſtronger than thoſe of pleaſure. The infant's cries are ſufficient indications of the uneaſineſſes it muſt at every interval endure; while, in the beginning, it has got no external marks to teſtify its ſatisfactions. It is not till after forty days that it is ſeen to ſmile; and not till that time alſo, the tears begin to appear, its former expreſſions of uneaſineſs being always without them. As to any other marks of the paſſions, the infant being as yet almoſt without them, it can expreſs none of them in its viſage; which, except in the act of crying and laughing, is fixed in a ſettled ſerenity. All the other parts of the body ſeem equally relaxed and feeble: its motions are uncertain, and its poſtures without choice; it is unable to ſtand upright; its hams are yet bent, from the habit which it received from its poſition in the womb; it has not ſtrength enough in its arms to ſtretch them forward, much leſs to graſp any thing with its hands; it reſts juſt in the poſture it is laid; and, if abandoned, muſt continue in the ſame poſition.

Never-

Nevertheleſs, though this be the deſcription of infancy among mankind in general, there are countries, and races, among whom infancy does not ſeem marked with ſuch utter imbecillity, but where the children, not long after they are born, appear poſſeſſed of a greater ſhare of ſelf-ſupport. The children of Negroes have a ſurpriſing degree of this premature induſtry: they are able to walk at two months; or, at leaſt, to move from one place to another: they alſo hang to the mother's back without any aſſiſtance, and ſeize the breaſt over her ſhoulder, continuing in this poſture till ſhe thinks proper to lay them down. This is very different in the children of our countries, that ſeldom are able to walk under a twelvemonth.

The ſkin of children newly brought forth, is always red, proceeding from its tranſparency, by which the blood beneath appears more conſpicuous. Some ſay that this redneſs is greateſt in thoſe children that are afterwards about to have the fineſt complexions; and it appears reaſonable that it ſhould be ſo, ſince the thinneſt ſkins are always the faireſt. The ſize of a new-born infant is generally about twenty inches, and its weight about twelve pounds. The head is large, and all the members delicate, ſoft, and puffy. Theſe appearances alter with its age; as it grows older, the head becomes leſs in proportion to the reſt of the body; the fleſh hardens: the bones that before birth grew very thick in proportion, now lengthen by degrees, and the human figure more and more acquires its due dimenſions. In ſuch children, however, as are but feeble or ſickly, the head always continues too big for the body; the heads of dwarfs being extremely large in proportion.

Infants, when newly born, paſs moſt of their time in ſleeping, and awake with crying, excited either by ſenſations of pain, or of hunger. Man, when come to maturity, but rarely feels the want of food, as eating twice or thrice in the four and twenty hours is known to ſuffice the moſt voracious: but the infant may be conſidered as a little glutton, whoſe only pleaſure conſiſts in its appetite; and this, except when it ſleeps, it is never eaſy without ſatisfying. Thus Nature has adapted different deſires to the different periods of life; each as it ſeems moſt neceſſary for human ſupport or ſucceſſion. While the animal is yet forming, hunger excites it to that ſupply which is neceſſary for its growth; when it is completely formed, a different appetite takes place, that incites it to communicate exiſtence. Theſe two deſires take up the whole attention at different periods, but are very ſeldom found to prevail ſtrongly together in the ſame age; one pleaſure ever ſerving to repreſs the other: and, if we find a perſon of full age, placing a principal part of his happineſs in the nature and quantity of his food, we have ſtrong reaſons to ſuſpect, that with reſpect to his other appetites, he ſtill retains a part of the imbecillity of his childhood.

It is extraordinary, however, that infants, who are thus more voracious than grown perſons, are nevertheleſs more capable of ſuſtaining hunger. We have ſeveral inſtances, in accidental caſes of famine, in which the child has been known to ſurvive the parent; and ſeen clinging to the breaſt of their dead mother. Their little bodies alſo, are more patient of cold; and we have ſimilar inſtances of the mother's periſhing in the ſnow, while the infant has been found alive beſide her. However, if we examine the internal ſtructure of infants, we ſhall find an obvious reaſon for both theſe advantages. Their blood-veſſels are known to be much larger than in adults; and their nerves much thicker and ſofter; thus, being furniſhed with a more copious quantity of juices, both of the nervous and ſanguinary kinds, the infant finds a temporary ſuſtenance in this ſuperfluity, and does not expire till both are exhauſted. The circulation alſo being larger and quicker, ſupplies it with proportionable warmth, ſo that it is more capable of reſiſting the accidental rigours of the weather.

The firſt nouriſhment of infants is well known to be the mother's milk; and, what is remarkable, the infant has milk in its own breaſts, which may be ſqueezed out by compreſſion: this nouriſhment becomes leſs grateful as the child gathers ſtrength; and perhaps, alſo, more unwholſome. However, in cold countries, which are unfavourable to propagation, and where the female has ſeldom above three or four children at the moſt, during her life, ſhe continues to ſuckle the child for four or five years together. In this manner the mothers of Canada and Greenland are often ſeen ſuckling two or three children, of different ages, at a time.

The life of infants is very precarious, till the age age of three or four, from which time it becomes more ſecure; and when a child arrives at its ſeventh year, it is then conſidered as a more certain life, as Mr. Buffon aſſerts, than at any other age whatever. It appears, from Simpſon's Tables, that of a certain number of children born at the ſame time, a fourth part are found dead, at the end of the firſt year; more than two thirds at the end of the ſecond; and, at leaſt, half, at the end of the third: ſo that thoſe who live to be above three years old, are indulged a longer term than half the reſt of their fellow-creatures. Nevertheleſs, life, at that period, may be conſidered as mere animal exiſtence; and rather a preparation for, than an enjoyment of thoſe ſatisfactions, both of mind and body, that make life of real value: and hence it is more natural for mankind to deplore a fellow-creature, cut off in the bloom of life, than one dying in early infancy. The one, by living up to youth, and thus wading through the diſadvantageous parts of exiſtence, ſeems to have earned a ſhort continuance of its enjoyments; the infant, on the contrary, has ſerved but a ſhort apprenticeſhip to pain; and, when taken away, may be conſidered as reſcued from a long continuance of miſery.

There is ſomething very remarkable in the growth of the human body. The embryo in the womb continues to increaſe ſtill more and more, till it is born. On the other hand, the child's growth is leſs every year till the time of puberty, when it ſeems to ſtart up of a ſudden. Thus, for inſtance, the embryo, which is an inch long, in the firſt month, grows but one inch and a quarter in the ſecond; it then grows one and a half in the third; two and a half in the fourth; and in this manner it keeps increaſing, till in the laſt month of its continuance, it is actually found to grow four inches; and, in the whole, about eighteen inches long. But it is otherwiſe with the child when born: if we ſuppoſe it eighteen inches at that time, it grows, in the firſt year, ſix or ſeven inches; in the ſecond year, it grows but four inches; in the third year about three; and ſo on, at the rate of about an inch and a half or two inches, each year, till the time of puberty, when Nature ſeems to make one great laſt effort, to complete her work, and unfold the whole animal machine.

The growth of the mind in children ſeems to correſpond with that of the body. The comparative progreſs of the underſtanding is greater in infants than in children of three or four years old. If we only reflect a moment on the amazing acquiſitions that an infant makes in the firſt and ſecond years of life, we ſhall have much cauſe for wonder. Being ſent into a world where every thing is new and unknown, the firſt months of life are ſpent in a kind of torpid amazement, an attention diſtracted by the multiplicity of objects that preſs to be

be known. The first labour, therefore, of the little learner is, to correct the illusions of the senses, to distinguish one object from another, and to exert the memory, so as to know them again. In this manner a child of a year old has already made a thousand experiments; all which it has properly ranged, and distinctly remembers. Light, heat, fire, sweets, and bitters, sounds soft or terrible, are all distinguished at the end of a very few months. Besides this, every person the child knows, every individual object it becomes fond of, its rattles, or its bells, may be all considered as so many new lessons to the young mind, with which it has not become acquainted, without repeated exertions of the understanding. At this period of life, the knowledge of every individual object cannot be acquired without the same effort which, when grown up, is employed upon the most abstract idea: every thing the child hears or sees, all the marks and characters of nature, are as much unknown, and require the same attention to attain, as if the reader were set to understand the characters of an Ethiopic manuscript: and yet we see in how short a time the little student begins to understand them all, and to give evident marks of early industry.

It is very amusing to pursue the young mind, while employed in its first attainments. At about a year old, the same necessities that first engaged its faculties, increase, as its acquaintance with nature enlarges. Its studies, therefore, if we may so express it, are no way relaxed; for having experienced what gave pleasure at one time, it desires a repetition of it from the same object; and, in order to obtain this, that object must be pointed out: here, therefore, a new necessity arises, which, very often, neither its little arts nor importunities can remove; so that the child is at last obliged to set about naming the objects it desires to possess or avoid. In beginning to speak, which is usually about a year old, children find a thousand difficulties. It is not without repeated trials that they come to pronounce any one of the letters; nor without an effort of the memory, that they can retain them. For this reason, we frequently see them attempting a sound which they had learned, but forgot; and when they have failed, their attempt is often attended with apparent confusion. The letters soonest learned, are those which are most easily formed; thus A and B require an obvious disposition of the organs, and their pronunciation is consequently soon attained. Z and R, which require a more complicated position, are learned with greater difficulty. And this may, perhaps, be the reason why the children in some countries speak sooner than in others; for the letters, mostly occurring in the language of one country, being such as are of easy pronunciation, that language is of course more easily attained. In this manner the children of the Italians are said to speak sooner than those of the Germans; the language of the one being smooth and open; that of the other, crowded with consonants, and extremely guttural.

But be this as it will, in all countries, children are found able to express the greatest part of their wants by the time they arrive at two years old; and from the moment the necessity of learning new words ceases, they relax their industry. It is then that the mind, like the body, seems every year to make slow advances; and, in order to spur up attention, many systems of education have been contrived.

Almost every philosopher who has written on the education of children, has been willing to point out a method of his own, chiefly professing to advance the health, and improve the intellects at the same time. These are usually found to begin with finding nothing right in the common practice; and by urging a total reformation. In consequence of this, nothing can be more wild or imaginary than their various systems of improvement. Some will have the children every day plunged in cold water, in order to strengthen their bodies; they will have them converse with the servants in nothing but the Latin language, in order to strengthen their minds; every hour of the day must be appointed for its own studies, and the child must learn to make these very studies an amusement; till, about the age of ten or eleven it becomes a prodigy of premature improvement. Quite opposite to this, we have others, whom the courtesy of mankind also calls philosophers: and they will have the child learn nothing till the age of ten or eleven, at which the former has attained so much perfection; with them the mind is to be kept empty, until it has a proper distinction of some metaphysical ideas about truth; and the promising pupil is debarred the use of even his own faculties, lest they should conduct him into prejudice and error. In this manner, some men, whom fashion has celebrated for profound and fine thinkers, have given their hazarded and untried conjectures, upon one of the most important subjects in the world, and the most interesting to humanity. When men speculate at liberty upon innate ideas, or the abstracted distinctions between will and power, they may be permitted to enjoy their systems at pleasure, as they are harmless, although they may be wrong; but when they alledge that children are to be every day plunged in cold water, and, whatever be their constitution, indiscriminately inured to cold and moisture; that they are to be kept wet in the feet, to prevent their catching cold; and never to be corrected when young, for fear of breaking their spirits when old; these are such noxious errors, that all reasonable men should endeavour to oppose them. Many have been the children whom these opinions began in speculation, have injured or destroyed in practice.

If any system be therefore necessary, it is one that would serve to shew, a very plain point; that very little system is necessary. The natural and common course of education is in every respect the best: We mean that in which the child is permitted to play among its little equals, from whose similar instructions it often gains the most useful stores of knowledge. A child is not idle because it is playing about the fields, or pursuing a butterfly; it is all this time storing its mind with objects, upon the nature, the properties, and the relations of which future curiosity may speculate.

It is a vain task to try to make a child's learning its amusement; nor would it answer any good end were it actually attained. The child, as was said, ought to have its share of play, and it will be benefited thereby; and for every reason also, it ought to have its share of labour. The mind, by early labour, will be thus accustomed to fatigues and subordination; and whatever be the person's future employment in life, he will be better fitted to endure it: he will be thus enabled to support the drudgeries of office, with content; or to fill up the vacancies of life with variety. The child, therefore, should by times be put to its duty; and be taught to know, that the task is to be done, or the punishment to be endured. We do not object against alluring it to duty by reward; but we well know, that the mind will be more strongly stimulated by pain; and both may, upon some occasions, take their turn to operate. In this manner, a child, by playing with its equals abroad, and labouring with them at school, will acquire more health and knowledge than by being bred up under the wing of any speculative system-maker; and will be thus qualified for a life of activity and obedience. It is true, indeed, that when educated in this manner, the boy may not be so

so seemingly sensible and forward as one bred up under solitary instruction; and, perhaps, this early forwardness is more engaging than useful. It is well known, that many of those children who have been such prodigies of literature before ten, have not made an adequate progress to twenty. It should seem, that they only began learning manly things before their time; and, while others were busied in picking up that knowledge adapted to their age and curiosity, these were forced upon subjects unsuited to their years; and, upon that account alone, appearing extraordinary. The stock of knowledge in both may be equal; but with this difference, that each is yet to learn what the other knows.

But whatever may have been the acquisitions of children at ten or twelve, their greatest, and most rapid progress, is made when they arrive near the age of puberty. It is then that all the powers of nature seem at work in strengthening the mind, and completing the body; the youth acquires courage, and the virgin modesty; the mind, with new sensations, assumes new powers; it conceives with greater force, and remembers with greater tenacity. About this time, therefore, which is various in different countries, more is learned in one year than in any two of the preceding: and on this age, in particular, the greatest weight of instruction ought to be thrown.

CHAP. IV.
Of PUBERTY.

IT is a common saying, that the season of youth is the season of pleasures: but this can only be true in savage countries, where but little preparation is made for the perfection of human nature; and where the mind has but a very small part in the enjoyment. It is otherwise in those places where nature is carried to the highest pitch of refinement, in which this season of the greatest sensual delight is wisely made subservient to the succeeding, and more rational one of manhood. Youth, with us, is but a scene of preparation; a drama, upon the right conduct of which all future happiness is to depend. The youth who follows his appetites, too soon seizes the cup, before it has received its best ingredients; and, by anticipating his pleasures, robs the remaining parts of life of their share; so that his eagerness only produces a manhood of imbecility, and an age of pain.

The time of puberty is different in various countries, and always more late in men than in women. In the warm countries, of India, the women are marriageable at nine or ten, and the men at twelve or thirteen. It is also different in cities where the inhabitants lead a more soft, luxurious life, from the country where they work harder, and fare less delicately. Its symptoms are seldom alike in different persons; but it is usually known by a swelling of the breasts in one sex, and a roughness of the voice in the other. At this season also, the women seem to acquire new beauty, while the men lose all that delicate effeminacy of countenance which they had when boys.

All countries, in proportion as they are civilized, or barbarous, improve, or degrade the nuptial satisfaction. In those miserable regions, where strength makes the only law, the stronger sex exerts its power, and becomes the tyrant over the weaker: while the inhabitant of Negroland is indolently taking his pleasure in the fields, his wife is obliged to till the grounds, that serve for their mutual support. It is thus in all barbarous countries, where the men throw all the laborious duties of life upon the women; and, regardless of beauty, put the softer sex to those employments that must effectually destroy it.

But, in countries that are half barbarous, particularly wherever Mahometanism prevails, the men run into the very opposite extreme. Equally brutal with the former, they exert their tyranny over the weaker sex, and consider that half of the human creation as merely made to be subservient to the depraved desires of the other. The chief, and indeed the only aim of an Asiatic, is to be possest of many women; and to be able to furnish a seraglio is the only tendency of his ambition. As the savage was totally regardless of beauty, he on the contrary, prizes it too highly; he excludes the person who is possest of such personal attractions, from any share in the duties, or employments of life; and, as if willing to engross all beauty to himself, increases the number of his captives in proportion to the progress of his fortune. In this manner he vainly expects to augment his satisfactions, by seeking from many that happiness which he ought to look for in the society of one alone. He lives a gloomy tyrant, amidst wretches of his own making; he feels none of those endearments which spring from affection, none of those delicacies which arise from knowledge. His mistresses, being shut out from the world, and totally ignorant of all that passes there, have no arts to entertain his mind, or calm his anxieties; the day passes with them in sullen silence, or languid repose; appetite can furnish but few opportunities of varying the scene; and all that falls beyond it must be irksome expectation.

From this avarice of women, if we may so express it, has proceeded that jealousy and suspicion which ever attends the miser: hence those low and barbarous methods of keeping the women of those countries guarded, and of making, and procuring eunuchs to attend them. These unhappy creatures are of two kinds, the white and the black. The white are generally made in the country where they reside, being but partly deprived of the marks of virility; the black are generally brought from the interior parts of Africa, and are made entirely bare. These are chiefly chosen for their deformity: the thicker the lips, the flatter the nose, and the more black the teeth, the more valuable the eunuch; so that the vile jealousy of mankind here inverts the order of Nature; and the poor wretch finds himself valued in proportion to his deficiencies. In Italy, where this barbarous custom is still retained, and eunuchs are made, in order to improve the voice, the laws are severely aimed against such practice; so that being entirely prohibited, none but the poorest, and most abandoned of the people, still secretly practice it upon their children. Of those served in this manner, not one in ten is found to become a singer; but such is the luxurious folly of the times, that the success of one amply compensates for the failure of the rest. It is very difficult to account for the alterations which castration make in the voice, and the other parts of the body. The eunuch is shaped differently from others. His legs are of an equal thickness above and below; his knees weak; his shoulders narrow; and his beard thin and downy. In this manner his person is rendered more deformed; but his desires, as we are told, still continue the same; and actually, in Asia, some of them are found to have their seraglios, as well as their masters. Even in our country, we have an instance of a very fine woman's being married to one of them, whose appearance was the most unpromising; and, what is more extraordinary still, this couple continue perfectly happy in each other's society.

The mere necessities of life seem the only aim of

the ſavage; the ſenſual pleaſures are the only ſtudy of the ſemi-barbarian; but, the refinement of ſenſuality, by reaſon, is the boaſt of real politeneſs. Among the merely barbarous nations, ſuch as the natives of Madagaſcar, or the inhabitants of Congo, nothing is deſired ſo ardently as to proſtitute their wives, or daughters, to ſtrangers, for the moſt trifling advantages; they will account it a diſhonour not to be among the foremoſt who are thus received into favour; on the other hand, the Mahometan keeps his wife faithful, by confining her perſon; and would inſtantly put her to death if he but ſuſpected her chaſtity. With the politer inhabitants of Europe both theſe barbarous extremes are avoided; the woman's perſon is left free, and no conſtraint is impoſed but upon her affections. The paſſion of love, which may be conſidered as the nice conduct of ruder deſire, is only known, and practiſed in this part of the world; ſo that what other nations guard as their right, the more delicate European is contented to aſk as a favour. In this manner, the concurrence of mutual appetite contributes to increaſe mutual ſatisfaction; and the power on one ſide of refuſing, makes every bleſſing more grateful when obtained by the other. In barbarous countries, woman is conſidered merely as an uſeful ſlave; in ſuch as are ſomewhat more refined, ſhe is regarded as a deſireable toy; in countries entirely poliſhed, ſhe enjoys juſter privileges; the wife being conſidered as an uſeful friend, and an agreeable miſtreſs. Her mind is ſtill more prized than her perſon; and without the improvement of both, ſhe can never expect to become truly agreeable; for her good ſenſe alone can preſerve what ſhe has gained by her beauty.

Female beauty, as was ſaid, is always ſeen to improve about the age of puberty; but, if we ſhould attempt to define in what this beauty conſiſts or what conſtitutes its perfection, we ſhould find nothing more difficult to determine. Every country has its peculiar way of thinking, in this reſpect; and even the ſame country thinks differently, at different times. The ancients had a very different taſte from what prevails at preſent. The eye-brows joining in the middle was conſidered as a very peculiar grace, by Tibullus, in the enumeration of the charms of his miſtreſs. Narrow forcheads were approved of, and ſcarce any of the Roman ladies that are celebrated for their other perfections, but are alſo praiſed for the redneſs of their hair. The noſe alſo of the Grecian Venus, was ſuch as would appear at preſent an actual deformity; as it fell in a ſtraight line from the forehead, without the ſmalleſt ſinking between the eyes; without which we never ſee a face at preſent.

Among the moderns, every country ſeems to have peculiar ideas of beauty. The Perſians admire large eye-brows, joining in the middle; the edges and corners of the eyes are tinctured with black, and the ſize of the head is increaſed by a great variety of bandages, formed into a turban. In ſome parts of India, black teeth and white hair, are deſired with ardour; and one of the principal employments of the women of Thibet, is to redden the teeth with herbs, and to make their hair white by a certain preparation. The paſſion for coloured teeth obtains alſo in China, and Japan; where, to complete their idea of beauty, the object of deſire muſt have little eyes, nearly cloſed, feet extremely ſmall, and a waiſt far from being ſhapely. There are ſome nations of the American Indians, that flatten the head of their children, by keeping them, while young, ſqueezed between two boards, ſo as to make the viſage much larger than it would naturally be. Others flatten the head at top; and others make it as round as they poſſibly can. The inhabitants along the weſtern coaſts of Africa, have a very extraordinary taſte for beauty. A flat noſe, thick lips, and a jet black complexion, are there the moſt indulgent gifts of Nature. Such, indeed, they are all, in ſome degree, found to poſſeſs. However, they take care, by art, to increaſe the natural deformities, as they ſhould ſeem to us; and they have many additional methods of rendering the perſons ſtill more frightfully pleaſing. The whole body and viſage is often ſcarred with the variety of monſtrous figures; which is not done without great pain, and repeated inciſion; and even ſometimes, parts of the body are cut away. But it would be endleſs to remark the various arts which caprice, or cuſtom, has employed to diſtort and disfigure the body, in order to render it more pleaſing: in fact, every nation, how barbarous ſoever, ſeems unſatisfied with the human figure, as Nature has left it, and has its peculiar arts of heightening beauty. Painting, powdering, cutting, boring the noſe, and the ears, lengthening the one, and depreſſing the other, are arts practiſed in many countries, and, in ſome degree, admired in all. Theſe arts might have been at firſt introduced to hide epidemic deformities; cuſtom, by degrees, reconciles them to the view; till, from looking upon them with indifference, the eye at length begins to gaze with pleaſure.

CHAP. V.

Of the Age of MANHOOD.

THE human body attains its full heighth during the age of puberty; or, at leaſt a ſhort time after. Some young people ceaſe growing at fourteen, or fifteen; while others continue their growth till two or three and twenty. During this period they are moſtly of ſlender make, their thighs and legs ſmall, and the muſcular parts as yet unfilled: but, by degrees, the fleſhy fibres augment; the muſcles ſwell, and aſſume their figure; the limbs become more proportioned, and more round; and, before the age of thirty, the body, in men, has acquired its moſt perfect ſymmetry.

In women, the body attains this ſymmetry much ſooner, as with them the age of maturity is much earlier: the muſcles, and all the other parts being leſs ſtrong, leſs compact, and leſs ſolid than thoſe of men, they require leſs time in coming to perfection; and, as they are leſs in ſize, that ſize is ſooner completed. Hence it is, that the perſons of women are found to be as complete at twenty, as thoſe of men are found to be at thirty.

The body of a well-ſhaped man ought to be ſquare, the muſcles expreſſed with boldneſs, and the lines of the face diſtinctly marked. In women ſuperior elegance prevails; her form is more delicate and more ſmooth. Strength and majeſty belong to the former, grace and ſoftneſs are the peculiar embelliſhments of the latter.

In both, does each part even of their form declare their ſovereignty over every living creature. Man ſupports his body erect; his attitude is that of command; and his face, which is turned towards the heavens, diſplays the dignity of his ſtation. The image of his ſoul is painted in his countenance; and the excellence of his nature penetrates through the material form in which it is incloſed. His majeſtic port, his ſedate, and reſolute ſtep, announce the ſuperiority of his rank. He touches the earth only with his extremity; and beholds it as if at a diſdainful diſtance. His arms are not given to him for pillars of ſupport; nor, by rendering his hands callous againſt the ground, does he loſe the delicacy of which the hand is the principal organ. The arms and hands are formed for very different purpoſes;

they are formed to second every intention of his will, and to perfect the gifts of Nature.

When the soul is at rest, all the features of the visage seem settled in a state of profound tranquility. Their proportion, their union, their harmony, seem to mark the sweet serenity of the mind, and to give a true information of what passes within. When the soul, however, is excited, the human visage becomes a living picture; where the passions are expressed with as much delicacy as energy, where every motion is designed by some correspondent feature, where every impression anticipates the will, and betrays those hidden agitations, that he would often wish to conceal.

It is particularly in the eyes that the passions are painted; and in which we may most readily discover their beginning. The eye seems to belong to the soul more than any other organ; it seems to participate of all its emotions; as well the most soft and tender, as the most violent and tumultuous. These it not only receives, but transmits by sympathy; the observing the eye of one catches the secret fire from another; and thus the passion often becomes general.

Such persons as are short-sighted, labour under a particular disadvantage, in this respect. They are, in a manner, entirely cut off from the language of the eyes; and this gives an air of stupidity to the face, which often produces very unfavourable prepossessions. However intelligent we may find such persons, it is with difficulty that we renounce our former prejudices against them. In this manner, we are too much induced to judge of men by their physiognomy; and having perhaps, at first, caught up our judgments prematurely, they mechanically influence us all our lives after. This extends even to the very colour, or the cut of people's cloaths; and we should for this reason be careful, even in such trifling particulars, since an article so paltry as dress go to make up a part of the total judgment which those we converse with may form to our advantage.

The vivacity, or the languid motion of the eyes, gives the strongest marks to physiognomy; and their colour contributes still more to enforce the expression. The different colours of the eye are the dark-hazle, the light-hazle, the green, the blue, the grey, the whitish-grey, and also the red. These different colours arise from the different colours of the little muscles that serve to contract the pupils, and they are very often found to change colour with disorder, and with age.

Those most frequent are, the hazle and the blue, and very often, both these colours are found in the eyes of the same person. Those eyes which are called black, are only of the dark-hazle, which may be easily seen upon closer inspection; however, those eyes are reckoned the most beautiful where the shade is the deepest; and either in these, or the blue eyes, the fire, which gives to the eye its finest expression, is more distinguishable in proportion to the darkness of the tint. For this reason, the black eyes, as they are called, have the greatest vivacity; but, probably, the blue have the most powerful effects in beauty, as they reflect a greater variety of lights, being composed of more various colours.

This variety, which is found in the colour of the eyes, is peculiar to man, and one or two of the brute-creation: but, in general, the colour in any one individual is the same in all the rest. The eyes of oxen are brown; those of sheep of a water-colour; those of goats are grey, &c. and it may also be, in general remarked, that the eyes of most white animals are red; thus the rabbit, the ferrit, and, even in the human race, the white Moor, all have their eyes of a red colour.

Though the eye, when put into motion, seems to be drawn on one side, yet it only moves round its centre, by which its coloured part moves nearer, or farther from the angle of the eye-lids, or is elevated or depressed. The distance between the eyes is less in man than in any other animal; and in some of these it is so great, that it is impossible that they should ever view the same object with both eyes at once, unless it be at a great distance.

Next to the eyes, the features, which most give a character to the face, are the eye-brows; which being in some measure more apparent than the other features, are most readily distinguished at a distance.

The eye-lashes have an effect, in giving expression to the eye, particularly when long and close; they soften its glances, and improve its sweetness. Man and apes are the only animals that have eye lashes both upon the upper and lower lids; all other animals want them on the lid below.

The eye-lids serve to guard the ball of the eyes and to furnish it with a proper moisture. The upper lids rise and fall; the lower has scarce any motion; and though their being moved depends on the will, yet it often happens that the will is unable to keep them open, when sleep, or fatigue, oppresses the mind. In birds, and amphibious quadrupeds, the lower lid alone has motion; fishes and insects have no eye-lids whatsoever.

The forehead makes a large part of the face, and a part which chiefly contributes to its beauty. It ought to be justly proportioned; neither too round nor too flat, neither too narrow nor too low, and the hair should come thick upon its extremities. It is known to every body how much the hair tends to improve the face; and how much the being bald serves to take away from beauty. The highest part of the head is that which becomes bald the soonest, as well as that part which lies immediately above the temples; and as for the hair under the temples, and at the back of the head, it is seldom known to fail.

Of all parts, or appendages of the body, the hair is that which is found most different, in different climates; and often, it not only contributes to mark the country, but also the disposition of the man. It is in general thickest where the constitution is strongest; and more glossy and beautiful where the health is most permanent. The ancients held the hair to be a sort of excrement, produced like the nails; the part next the root pushing out that immediately contiguous. But the moderns have found that every hair may be truly said to live, to receive nutriment, to fill and distend itself like the other parts of the body. The roots, they observe, do not turn grey sooner than the extremities, but the whole hair changes colour at once; and we have many instances of persons who have grown grey in one night's time.

The nose is the most prominent feature in the face; but, as it has scarce any motion, and that only in the strongest passions, it rather adds to the beauty, than to the expression of the countenance.

The form of this feature, and its advanced position, are peculiar to the human visage alone. Other animals, for the most part, have nostrils, with a partition between them; but none of them have an elevated nose. Apes themselves have scarce any thing else of this feature, but the nostrils; the rest of the feature lying flat upon the visage, and scarce higher than the cheek-bones.

The mouth and lips, next to the eyes, are found to have the greatest expression. The passions have great power over this part of the face, and the mouth marks its different degrees, by its different forms. The organ of speech still more animates this part, and give it more life than any other feature in the countenance. The ruby colour of the lips, and the white

white enamel of the teeth, give it such a superiority over every other feature, that it seems to make the principal object of our regards. In fact, the whole attention is fixed upon the lips of the speaker, however rapid his discourse, however various the subject, the mouth takes correspondent situations; and deaf men have been often found to see the force of those reasonings which they could not hear, understanding every word as it was spoken.

The under jaw in man possesses a great variety of motions; while the upper has been thought, by many, to be quite immoveable. However, that it moves in man, a very easy experiment will suffice to convince us. If we keep the head fixed with any thing between our teeth, the edge of a table for instance, and then open our mouths, we shall find that both jaws recede from it at the same time; the upper jaw rises, the lower falls, and the table remains untouched between them. The upper jaw has motion as well as the under; and, what is remarkable, it has its proper muscles behind the head, for thus raising and depressing it. Whenever, therefore, we eat, both jaws move at the same time, though very unequally; for the whole head moving with the upper jaw, of which it makes a part, its motions are thus less observable. In the human embryo, the under jaw is very much advanced before the upper. In the adult, it hangs a good deal more backward; and those whose upper and under row of teeth are equally prominent, and strike directly against each other, are what the painters call underhung; and they consider this as a great defect in beauty. The under jaw in a Chinese face falls greatly more backward than with us; and the difference is half an inch, when the mouth is shut naturally. In instances of the most violent passion, the under jaw has often an involuntary quivering motion; and often also, a state of langour produces another, which is that of yawning. Every one knows how very sympathetic this kind of languid motion is; and that for one person to yawn, is sufficient to set all the rest of the company a yawning. A ridiculous instance of this was commonly practised upon the famous M'Laurin, one of the professors at Edinburgh. He was very subject to have his jaw dislocated; so that when he opened his mouth wider than ordinary, or when he yawned, he could not shut it again. In the midst of his harangues, therefore, if any of his pupils began to be tired of his lecture, he had only to gape or yawn, and the professor instantly caught the sympathetic affection; so that he thus continued to stand speechless, with his mouth wide open, till his servant, from the next room, was called in to set his jaw again.

When the mind reflects with regret upon some good unattained or lost, it feels an internal emotion, which acting upon the diaphragm, and that upon the lungs, produces a sigh; this when the mind is strongly affected, is repeated; sorrow succeeds these first emotions; and tears are often seen to follow; sobbing is the sigh still more invigorated; and lamentation, or crying, proceeds from the continuance of the plaintive tone of the voice, which seems to implore pity. There is yet a silent agony, in which the mind appears to disdain all external help, and broods over its distresses with gloomy reserve. This is the most dangerous state of mind; accidents, or friendship may lessen the louder kinds of grief; but all remedies for this, must be had from within; and there, despair too often finds the most deadly enemy.

Laughter is a sound of the voice, interrupted and pursued for some continuance. The muscles of the belly, and the diaphragm, are employed in the slightest exertions; but those of the ribs are strongly agitated in the louder: and the head sometimes is thrown backward, in order to raise them with greater ease. The smile is often an indication of kindness and good-will: it is also often used as a mark of contempt and ridicule.

Blushing proceeds from different passions; being produced by shame, anger, pride, and joy. Paleness is often also the effect of anger; and almost ever attendant on fright and fear. These alterations in the colour of the countenance, are entirely involuntary; all the other expressions of the passions are, in some small degree, under controul; but blushing and paleness, betray our secret purposes; and we might as well attempt to stop them, as the circulation of the blood, by which they are caused.

The whole head, as well as the features of the face, takes peculiar attitudes from its passions; it bends forward, to express humility, shame, or sorrow; it is turned to one side, in langour, or in pity; it is thrown with the chin forward, in arrogance and pride; erect, in self-conceit, and obstinacy; it is thrown backwards in astonishment; and combines its motion to the one side, and the other, to express contempt, ridicule, anger, and resentment. Painters, whose study leads to the contemplation of external forms, are much more adequate judges of these than any naturalist can be; and it is with these a general remark, that no one passion is regularly expressed on different countenances in the same manner; but that grief often sits upon the face like joy; and pride assumes the air of passion. It would be vain, therefore, in words, to express their general effect, since they are often as various as the countenances they sit upon; and in making this distinction nicely, lies all the skill of the physiognomist. In being able to distinguish what part of the face is marked by nature, and what by the mind; what part has been originally formed, and what is made by habit, constitutes this science, upon which the ancients so much valued themselves, and which we at present so little regard. Some, however, of the most acute men among us, have paid great attention to this art; and, by long practice, have been able to give some character of every person whose face they examined. Montaigne is well known to have disliked those men who shut one eye in looking upon any object; and Fielding asserts, that he never knew a person with a steady glavering smile, but he found him a rogue. However, most of these observations, tending to a discovery of the mind by the face, are merely capricious; and Nature has kindly hid our hearts from each other to keep us in good humour with our fellow creatures.

The parts of the head which give the least expression to the face, are the ears; and they are generally found hidden under the hair. These, which are immoveable, and make so small an appearance in man, are very distinguishable features in quadrupeds. They serve in them as the principal marks of the passion; the ears discover their joys or their terrors, with tolerable precision; and denote all their internal agitations. The smallest ears, in men, are said to be most beautiful; but the largest are found the best for hearing. There are some savage nations who bore their ears, and so draw that part down, that the tip of the ears are seen to rest upon their shoulders.

The strange variety in the different customs of men, appears still more extravagant in their manner of wearing their beards. Some, and among others the Turks, cut the hair off their heads, and let their beards grow. The Europeans, on the contrary, shave their beards, and wear their hair. The Negroes shave their heads in figures at one time, in stars at another, in the manner of friars; and still more commonly in alternate stripes; and their little boys are shaved in the same manner. The Talapoins, of Siam, shave the heads and the eye-brows of such children as are committed to their care.

Every nation ſeems to have entertained different prejudices, at different times, in favour of one part or another of the beard. Some have admired the hair upon the cheeks on each ſide, as we ſee with ſome low-bred men among ourſelves, who want to be fine. Some like the hair lower down; ſome chuſe it curled; and others, like it ſtrait. Some have cut it into a peak; and others ſhave all but the whiſker. This particular part of the beard, was highly prized among the Spaniards; till of late, a man without whiſkers was conſidered as unfit for company; and where Nature had denied them, Art took care to ſupply the deficiency. We are told of a Spaniſh general, who, when he borrowed a large ſum of money from the Venetians, pawned his whiſker, which he afterwards took proper care to releaſe. Kingſon aſſures us, that a conſiderable part of the religion of the Tartars conſiſts in the management of their whiſkers; and that they waged a long and bloody war with the Perſians, declaring them infidels, merely becauſe they would not give their whiſkers the orthodox cut. The kings of Perſia carried the care of their beards to a ridiculous exceſs, when they choſe to wear them matted with gold thread; and even the kings of France of the firſt race, had them knotted and buttoned with gold. But of all nations, the Americans take the greateſt pains in cutting their hair, and plucking their beards. The under part of the beard, and all but the whiſker, they take care to pluck up by the roots, ſo that many have ſuppoſed them to have no hair naturally growing on that part: and even Linnæus has fallen into that miſtake. Their hair is alſo cut into bands; and no ſmall care employed in adjuſting the whiſker. In fact, we have a very wrong idea of ſavage finery; and are apt to ſuppoſe that, like the beaſts of the foreſt, they riſe, and are dreſſed with a ſhake: but the reverſe is true; for no birth-night beauty takes more time or pains in the adorning her perſon, than they. When the Cherokee kings were over here, they were often three hours in dreſſing. They never would venture to make their appearance till they had gone through the tedious ceremonies of the toilet; they had their boxes of oil and ochre, their fat, and their perfumes, like the moſt effeminate beau, and generally took up four hours in dreſſing, before they conſidered themſelves as fit to be ſeen. We muſt not, therefore, conſider a delicacy in point of dreſs, as a mark of refinement, ſince ſavages are much more difficult in this particular, than the moſt faſhionable or tawdry European. The more barbarous the people, the fonder of finery. In Europe, the luſtre of jewels, and the ſplendor of the moſt brilliant colours, are generally given up to women, or to the weakeſt part of the other ſex, who are willing to be contemptibly fine; but in Aſia, theſe trifling fineries are eagerly ſought after by every condition of men; and, as the proverb has it, we find the richeſt jewels in an Ethiop's ear. The paſſion for glittering ornaments, is ſtill ſtronger among the abſolute barbarians, who often exchange their whole ſtock of proviſions, and whatever elſe they happen to be poſſeſſed of, with our ſeamen, for a glaſs bead, or a looking-glaſs.

Although faſhions have ariſen in different countries from fancy and caprice, theſe, when they become general, deſerve examination. Mankind have always conſidered it as a matter of moment, and they will ever continue deſirous of drawing the attention of each other, by ſuch ornaments as mark the riches, the power, or the courage of the wearer. The value of thoſe ſhining ſtones which have at all times been conſidered as precious ornaments, is entirely founded upon their ſcarceneſs or their brilliancy. It is the ſame likewiſe, with reſpect to thoſe ſhining metals, the weight of which is ſo little regarded, when ſpread over our cloaths. Theſe ornaments are rather deſigned to draw the attention of others, than to add to any enjoyments of our own; and few there are that theſe ornaments will not ſerve to dazzle, and who can coolly diſtinguiſh between the metal and the man.

All things rare and brilliant, will, therefore, ever continue to be faſhionable, while men derive greater advantage from opulence than virtue; while the means of appearing conſiderable are more eaſily acquired, than the title to be conſidered. The firſt impreſſion we generally make, ariſes from our dreſs; and this varies, in conformity to our inclinations, and the manner in which we deſire to be conſidered. The modeſt man, or he who would wiſh to be thought ſo, deſires to ſhew the ſimplicity of his mind, by the plainneſs of his dreſs; the vain man, on the contrary, takes a pleaſure in diſplaying his ſuperiority, and is willing to incur the ſpectator's diſlike, ſo he does but excite his attention.

Another point of view which men have in dreſſing, is to increaſe the ſize of their figure; and to take up more room in the world than Nature ſeems to have allotted them. We deſire to ſwell out our cloaths by the ſtiffneſs of art, and raiſe our heels, while we add to the largeneſs of our heads. How bulky ſoever our dreſs may be, our vanities are ſtill more bulky. The largeneſs of the doctor's wig ariſes from the ſame pride, with the ſmallneſs of the beau's queue. Both want to have the ſize of their underſtanding, meaſured by the ſize of their heads.

There are ſome modes that ſeem to have a more reaſonable origin, which is to hide or to leſſen the defects of Nature. To take men altogether, there are many more deformed and plain, than beautiful and ſhapely. The former, as being the moſt numerous, give law to faſhion; and their laws are generally ſuch as are made in their own favour. The women begin to colour their cheeks with red, when the natural roſes are faded; and the younger are obliged to ſubmit, though not compelled by the ſame neceſſity. In all parts of the world, this cuſtom prevails more or leſs; and powdering and frizzing the hair, though not ſo general, ſeems to have ariſen from a ſimilar controul.

But leaving the draperies of the human picture let us return to the figure, unadorned by art. Man's head, whether conſidered externally or internally, is differently formed from that of all other animals, the monkey-kind only excepted, in which there is a ſtriking ſimilitude. There are ſome differences, however, which we ſhall take notice of in another place. The bodies of all quadrupede animals are covered with hair; but the head of man ſeems the part moſt adorned; and that more abundantly than in any other animal.

There is a very great variety in the teeth of all animals; ſome have them above and below; others have them in the under jaw only: in ſome they ſtand ſeparate from each other; while in ſome they are continued and united. The palate of ſome fiſhes is nothing elſe but a bony plate ſtudded with points, which perform the offices of teeth. All theſe ſubſtances, in every animal, derive their origin from the nerves, the ſubſtance of the nerves hardens by being expoſed to the air; and the nerves that terminate in the mouth, being thus expoſed, acquire a bony ſolidity. In this manner, the teeth and nails are formed in man; and in this manner alſo, the beak, the hoofs, the horns, and the talons of other animals, are found to be produced.

The neck ſupports the head, and unites it to the body. This part is much more conſiderable in the generality of quadrupeds, than in man. But fiſhes, and other animals that want lungs ſimilar to ours, have no neck whatſoever. Birds, in general, have the neck longer than any other kind of animals; thoſe

thoſe of them, which have ſhort claws, have alſo ſhort necks; thoſe, on the contrary, that have them long, are found to have the neck in proportion. In men, there is a lump upon the wind-pipe, formed by the thyroid cartilage, which is not to be ſeen in women; an Arabian fable ſays, that this is a part of the original apple, that has ſtuck in the man's throat by the way, but that the woman ſwallowed her part of it down.

The human breaſt is outwardly formed in a very different manner from that of other animals. It is larger in proportion to the ſize of the body; and none but man, and ſuch animals as make uſe of their fore feet as hands, ſuch as monkies, bats, and ſquirrels, are found to have thoſe bones called the clavicles, or, as we uſually term them, the collar-bones. The breaſts in women are larger than in men; however, they ſeem formed in the ſame manner; and, ſometimes, milk is found in the breaſts of men, as well as in thoſe of women. Among animals, there is a great variety in this part of the body. The teats of ſome, as in the ape and elephant, are like thoſe of men, being but two, and placed on each ſide of the breaſt. The teats of the bear amount to four. The ſheep has but two, placed between the hinder legs. Other animals, ſuch as the bitch, and the ſow, have them all along the belly; and, as they produce many young, they have a great many teats for their ſupport. The form alſo of the teats varies in different animals; and, in the ſame animal, at different ages. The boſom in females, ſeems to unite all our ideas of beauty, where the outline is continually changing, and the gradations are ſoft and regular.

The graceful fall of the ſhoulders, both in man and woman, conſtitute no ſmall part of beauty. In apes, though otherwiſe made like us, the ſhoulders are high, and drawn up on each ſide towards the ears. In man they fall by a gentle declivity; and the more ſo, in proportion to the beauty of his form. In fact, being high-ſhouldered, is not without reaſon conſidered as a deformity, for we find very ſickly perſons are always ſo; and people, when dying, are ever ſeen with their ſhoulders drawn up in a ſurpriſing manner. The muſcles that ſerve to raiſe the ribs, moſtly riſe near the ſhoulders; and the higher we raiſe the ſhoulders, we the more eaſily raiſe the ribs likewiſe. It happens, therefore, in the ſickly and the dying, who do not breathe without labour, that to raiſe the ribs they are obliged to call in the aſſiſtance of the ſhoulders; and thus their bodies aſſume, from habit, that form which they are ſo frequently obliged to aſſume. Women with child alſo are uſually ſeen to be high-ſhouldered; for the weight of the inferior parts drawing down the ribs, they are obliged to uſe every effort to elevate them, and thus they raiſe the ſhoulders of courſe.

The arms of men but very little reſemble the fore-feet of quadrupeds, and much leſs the wings of birds. The ape is the only animal that is poſſeſſed of hands and arms; but theſe are much more rudely faſhioned, and with leſs exact proportion than in men; the thumb not being ſo well oppoſed to the reſt of the fingers, in their hands, as in ours.

The form of the back is not much different in man from that of other quadrupede animals, only that the reins are more muſcular in him, and ſtronger. The buttock, however, in man, is different from that of all other animals whatſoever. What goes by that name, in other creatures, is only the upper part of the thigh: man being the only animal that ſupports himſelf perfectly erect, the largeneſs of this part is owing to the peculiarity of his poſition.

Man's feet alſo are different from thoſe of all other animals, thoſe even of apes not excepted. The foot of the ape is rather a kind of aukward hand; its toes, or rather fingers, are long, and that of the middle longeſt of all. This foot alſo wants the heel, as in man; the ſole is narrower, and leſs adapted to maintain the equilibrium of the body in walking, dancing or running.

The nails are leſs in man than in any other animal. If they were much longer than the extremities of the fingers, they would rather be prejudicial than ſerviceable, and obſtruct the management of the hand. Such ſavages as let them grow long make uſe of them in flaying animals, in tearing their fleſh, and ſuch like purpoſes; however, though their nails are conſiderably larger than ours, they are by no means to be compared to the hoofs, or the claws of other animals. They may ſometimes be ſeen longer indeed than the claws of any animal whatſoever, as we learn that the nails of ſome of the learned men in China are longer than their fingers. But theſe want that ſolidity which might give force to their exertions; and could never, in a ſtate of nature, have ſerved them for annoyance, or defence.

There is little known exactly with regard to the proportion of the human figure; and the beauty of the beſt ſtatues is better conceived by obſerving than by meaſuring them. The ſtatues of antiquity, which were at firſt copied after the human form, are now become the models of it; nor is there one man found whoſe perſon approaches to thoſe inimitable performances that have thus, in one figure, united the perfections of many. It is ſufficient to ſay that, from being at firſt models, they are now become originals; and are uſed to correct the deviations in that form from whence they were taken. We will not, however, pretend to give the proportions of the human body as taken from theſe, there being nothing more arbitrary, and which good painters themſelves ſo much contemn. Some, for inſtance, who have ſtudied after theſe, divide the body into ten times the length of the face, and others into eight. Some pretend to tell us that there is a ſimilitude of proportion in different parts of the body. Thus, that the hand is the length of the face; the thumb the length of the noſe; the ſpace between the eyes is the breadth of an eye; that the breadth of the thigh, at thickeſt, is double that of the thickeſt part of the leg, and treble the ſmalleſt; that the arms extended are as long as the figure is high; that the legs and thighs are half the length of the figure. All this, however, is extremely arbitrary; and the excellence of a ſhape, or the beauty of a ſtatue, reſults from the attitude and poſition of the whole, rather than any eſtabliſhed meaſurements, begun without experience, and adopted by caprice. In general, it may be remarked that the proportions alter in every age, and are obviouſly different in the two ſexes. In woman, the ſhoulders are narrower, and the neck proportionably longer than in men. The hips alſo are conſiderably larger, and the thighs much ſhorter than in men. Theſe proportions, however, vary greatly at different ages. In infancy the upper parts of the body are much larger than the lower; the legs and thighs do not conſtitute any thing like half the height of the whole figure; in proportion as the child increaſes in age, the inferior parts are found to lengthen; ſo that the body is not equally divided until it has acquired its full growth.

The ſize of men varies conſiderably. Men are ſaid to be tall who are from five feet eight inches to ſix feet high. The middle ſtature is from five feet five to five feet eight, and theſe are ſaid to be of ſmall ſtature who fall under theſe meaſures. However, it ought to be remarked, that the ſame perſon is always taller when he ariſes in the morning, than upon going to bed at night; and ſometimes there is an inch difference, and often more. Few perſons are ſenſible of this remarkable variation; and,

ſome

ſome ſay, it was firſt perceived in England, by a recruiting officer. He often found that thoſe men whom he had enliſted for ſoldiers, and anſwered to the appointed ſtandard at one time, fell ſhort of it when they came to be meaſured before the colonel, at the head quarters. This diminution in their ſize proceeded from the different times of the day, and the different ſtates of the body when they happened to be meaſured. If, as was ſaid, they were meaſured in the morning, after the night's refreſhment, they were found to be commonly half an inch, and very often a whole inch taller than if meaſured after the fatigues of the day; if they were meaſured when freſh, in the country, and before a long fatiguing march to the regiment, they were found to be an inch taller than when they arrived at their journey's end. All this is now well known among thoſe who recruit for the army; and the reaſon of this difference of ſtature is obvious. Between all the joints of the back-bone, which is compoſed of ſeveral pieces, there is a glutinous liquor depoſited, which ſerves, like oil in a machine, to give the parts an eaſy play upon each other. This lubricating liquor, or ſynovia, as the anatomiſts call it, is poured in during the ſeaſon of repoſe, and is conſumed by exerciſe and employment; ſo that in a body, after hard labour, there is ſcarce any of it remaining; but all the joints grow ſtiff, and their motion becomes hard and painful. It is from hence, therefore, that the body diminiſhes in ſtature. For this moiſture being drained away, from between the numerous joints of the back-bone, they lie cloſer upon each other; and their whole length is thus very ſenſibly diminiſhed; but ſleep, by reſtoring the fluid, again ſwells the ſpaces between the joints, and the whole is extended to its former dimenſions.

As the human body is thus often found to differ from itſelf in ſize, ſo it is found to differ in its weight alſo; and the ſame perſon, without any apparent cauſe, is found to be heavier at one time than another. If, after having eaten an hearty dinner, or having drank hard, the perſon ſhould find himſelf thus heavier, it would appear no way extraordinary; but the fact is, the body is very often found heavier ſome hours after eating an hearty meal, than immediately ſucceeding it. If, for inſtance, a perſon, fatigued by a day's hard labour, ſhould eat a plentiful ſupper, and then get himſelf weighed upon going to bed; after ſleeping ſoundly, if he is again weighed, he will find himſelf conſiderably heavier than before; and this difference is often found to amount to a pound, or ſometimes to a pound and a half. From whence this adventitious weight is derived is not eaſy to conceive; the body, during the whole night, appears rather plentifully perſpiring than imbibing any fluid, rather loſing than gaining moiſture; however, we have no reaſon to doubt but that either by the lungs, or, perhaps, by a peculiar ſet of pores, it is all this time inhaling a quantity of fluid, which thus increaſes the weight of the whole body, upon being weighed the next morning.

Although the human body is externally more delicate than any of the quadrupede kind, it is, notwithſtanding, extremely muſcular: and, perhaps, for its ſize, ſtronger than that of any other animal. If we ſhould offer to compare the ſtrength of the lion with that of man, we ſhould conſider that the claws of this animal give us a falſe idea of its power: we aſcribe to its force what is only the effects of its arms. Thoſe which man has received from Nature are not offenſive; happy had art never furniſhed him with any more terrible than thoſe which arm the paws of the lion!

But there is another manner of comparing the ſtrength of man with that of other animals, namely, by the weights which either can carry. We are aſſured that the porters of Conſtantinople, carry burthens of nine hundred pounds weight: Mr. Deſaguliers tells us of a man, who, by diſtributing weights in ſuch a manner as that every part of his body bore its ſhare, he was thus able to raiſe a weight of two thouſand pounds. An horſe, which is about ſeven times our bulk, would be thus able to raiſe a weight of fourteen thouſand pounds, if its ſtrength were in the ſame proportion. But the truth is, an horſe will not carry upon its back, above a weight of two or three hundred pounds; while a man, of confeſſedly inferior ſtrength, is thus able to ſupport two thouſand. Whence comes this ſeeming ſuperiority? The anſwer is obvious. Becauſe the load upon man's ſhoulder is placed to the greateſt advantage; while upon the horſe's back, it is placed at the greateſt diſadvantage. Let us ſuppoſe, for a moment, the man ſtanding as upright as poſſible, under the great load abovementioned. It is obvious that all the bones of his body may be compared to a pillar ſupporting a building, and that his muſcles have ſcarce any ſhare in this dangerous duty. However, they are not entirely inactive; as man, let him ſtand never ſo upright, will have ſome bending in the different parts of his body. The muſcles, therefore, give the bones ſome aſſiſtance, and that with the greateſt poſſible advantage. In this manner, a man has been found to ſupport two thouſand weight; but may be capable of ſupporting a ſtill greater. The manner in which this is done, is by ſtrapping the load round the ſhoulders of the perſon, who is to bear it by a machine, ſomething like that by which milk-veſſels, or water-buckets are carried. The load being thus placed on a ſcaffold, on each ſide, contrived for that purpoſe, and the man ſtanding erect in the midſt, all parts of the ſcaffold, except that where the man ſtands, are made to ſink; and thus the man maintaining his poſition, the load, whatever it is, becomes ſuſpended, and the column of his bones may be fairly ſaid to ſupport it. If, however, he ſhould but ever ſo little give way, he muſt inevitably drop; and no power of his can raiſe the weights again. But the caſe is very different with regard to a load laid upon an horſe. The coloumn of the bones there lies a different way; and a weight of five hundred pounds, as we are told, would break the back of the ſtrongeſt horſe that could be found. The great force of an horſe and other quadrupedes, is exerted when the load is in ſuch a poſition as that the column of the bones can be properly applied; which is lengthwiſe. When, therefore, we are to eſtimate the comparative ſtrength of an horſe, we are not to try what he can carry, but what he can draw; and, in this caſe, his amazing ſuperiority over man is eaſily diſcerned; for one horſe can draw a load that ten men cannot move. And in ſome caſes it happens that a draft horſe draws the better for being ſomewhat loaded; for, as the peaſants ſay, the load upon the back keeps him the better to the ground.

There is ſtill another way of eſtimating human ſtrength by the perſeverance and agility of our motions. Men, who are exerciſed in running, outſtrip horſes; or at leaſt hold their ſpeed for a longer continuance. In a journey, alſo, a man will walk down a horſe; and, after they have both continued to proceed for ſeveral days, the horſe will be quite tired, and the man will be freſher than in the beginning. The king's meſſengers of Iſpahan, who are hunters by profeſſion, go thirty-ſix leagues in fourteen hours. Travellers aſſure us that the Hottentots outſtrip lions in the chace; and that the ſavages, who hunt the elk, purſue with ſuch ſpeed, that they at laſt tire down and take it. We are told many very ſurpriſing things of the great ſwiftneſs of

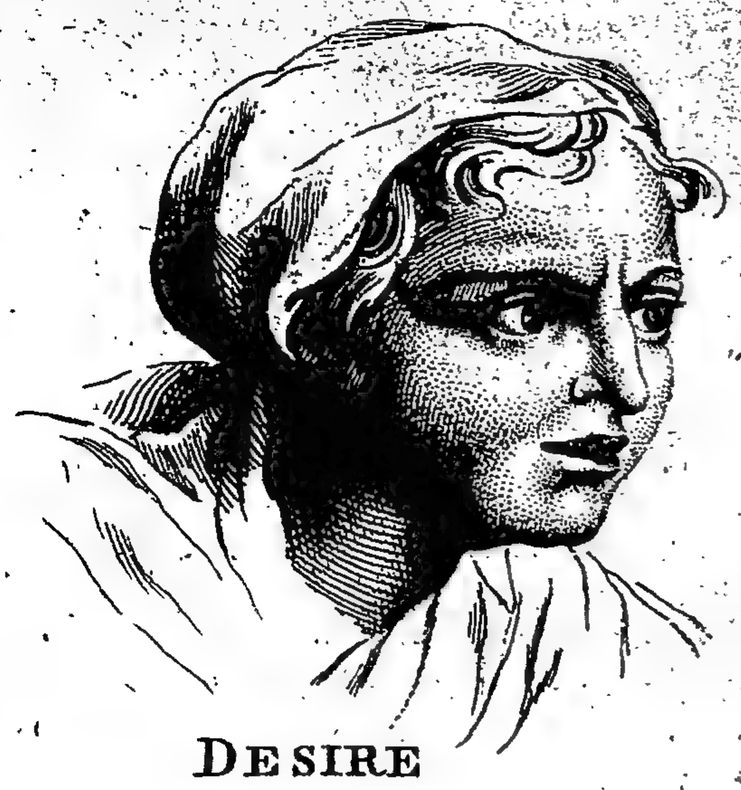
of the savages, and of the long journeys they undertake, on foot, through the most craggy mountains, where there are no paths to direct, nor houses to entertain them. They are said to perform a journey of twelve hundred leagues in less than six weeks. But, notwithstanding what travellers report of this matter, we have been assured, from many of our officers and soldiers, who compared their own swiftness, with that of the native Americans, during the last war, that although the savages held out, and, as the phrase is, had better bottoms, yet, for a spurt, the Englishmen were more nimble and speedy.

Nevertheless, in general, civilized man is ignorant of his own powers; he is ignorant how much he loses by effeminacy; and what might be acquired by habit and exercise. Here and there, indeed, men are found among us of extraordinary strength; but that strength, for want of opportunity, is seldom called into exertion. Among the ancients it was a quality of much greater use than at present; as in war the same man that had strength sufficient to carry the heaviest armour, had strength sufficient also to strike the most fatal blow. In this case, his strength was at once his protection and his power. We ought not to be surprised, therefore, when we hear of one man terrible to an army, and irresistible in his career, as we find some generals represented in ancient history. But we may be very certain that this prowess was exaggerated by flattery, and exalted by terror. An age of ignorance is ever an age of wonder. At such times, mankind, having no just ideas of the human powers, are willing rather to represent what they wish than what they know; and exalt human strength, to fill up the whole sphere of their limited conceptions. Great strength is an accidental thing; two, or three, in a country, may possess it; and these may have a claim to heroism. But what may lead us to doubt of the veracity of these accounts is, that the heroes of antiquity are represented as the sons of heroes; their amazing strength is delivered down from father to son; and this we know to be contrary to the course of nature. Strength is not hereditary; although titles are: and we are induced to believe, that this great tribe of heroes who are all represented as the descendants of heroes, are more obliged to their titles than to their strength, for their characters. With regard to the shining characters in Homer, they are all represented as princes, and as the sons of princes; while we are told of scarce any share of prowess in the meaner men of the army, who are only brought into the field for these to protect, or to slaughter. But nothing can be more unlikely than that those men, who were bred in the luxury of courts, should be strong; while the whole body of the people, who received a plainer and simpler education, should be comparatively weak! Nothing can be more contrary to the general laws of nature, than that all the sons of heroes should thus inherit not only the kingdoms, but the strength of their forefathers; and we may conclude, that they owe the greatest share of their imputed strength rather to the dignity of their stations than the force of their arms; and, like all fortunate princes, their flatterers happened to be believed. In later ages, indeed, we have some accounts of amazing strength, which we can have no reason to doubt of. But in these, nature is found to pursue her ordinary course; and we find their strength accidental. We find these strong men among the lowest of the people, and gradually rising into notice, as this superiority had more opportunity of being seen. Of this number was the Roman tribune, who went by the name of the second Achilles; who, with his own hand is said to have killed, at different times, three hundred of the enemy; and who treacherously set upon, by twenty-five of his own countrymen, although then past his sixtieth year, killed fourteen of them before he was slain. Of this number was Milo, who, when he stood upright, could not be forced out of his place. Pliny, also, tells us of one Athanatus, who walked across the stage at Rome, loaded with a breast-plate weighing five hundred pounds, and buskins of the same weight. But of all the prodigies of strength, of whom we have any accounts in Roman history, Maximin, the emperor, is to be reckoned the foremost. Whatever we are told relative to him is well attested; his character was too exalted not to be thoroughly known; and that very strength, for which he was celebrated, at last procured him no less a reward than the empire of the world. Maximin was above nine feet in height, and the best proportioned man in the whole empire. He was by birth a Thracian; and, from being a simple herdsman, rose through the gradations of office, until he came to be Emperor of Rome. The first opportunity he had of exerting his strength, was in the presence of all the citizens, in the theatre, where he overthrew twelve of the strongest men, in wrestling, and outstript two of the fleetest horses, in running, all in one day. He could draw a chariot loaden, that two strong horses could not move; he could break a horse's jaw with a blow of his fist; and its thigh with a kick. In war he was always foremost, and invincible; happy had it been for him, and his subjects, if, from being formidable to his enemies, he had not become still more so to his subjects; he reigned, for some time, with all the world his enemy; all mankind wishing him dead, yet none daring to strike the blow. As if fortune had resolved that through life he should continue unconquerable, he was killed at last by his own soldiers, while he was sleeping. We have many other instances, in later ages, of very great strength, and not fewer of amazing swiftness; but these, merely corporeal perfections, are now considered as of small advantage, either in war or in peace. The invention of gunpowder has, in some measure, levelled all force to one standard; and has wrought a total change in martial education through all parts of the world. In peace also, the invention of new machines every day, and the application of the strength of the lower animals to the purposes of life, have rendered human strength less valuable. The boast of corporeal force is therefore consigned to savage nations, where those arts not being introduced, it may still be needful; but, in more polite countries, few will be proud of that strength which other animals can be taught to exert to as useful purposes as they.

If we compare the largeness and thickness of our muscles with those of any other animal, we shall find that, in this respect, we have the advantage: and if strength, or swiftness, depended upon the quantity of the muscular flesh alone, in this respect we should be more active and powerful than any other. But this is not the case; a great deal more than the size of the muscles goes to constitute activity, or force; and it is not he who has the thickest legs that can make the best use of them. Those, therefore, who have written elaborate treatises on muscular force, and have estimated the strength of animals by the thickness of their muscles, have been employed to very little purpose. Thus, in general, observed that thin and raw-boned men are always stronger and more powerful than such as are seemingly more muscular; as in the former all the parts have better room for their exertions.

Women want much of the strength of men; and in some countries, the stronger sex have availed themselves of this superiority, in cruelly and tyrannically enslaving those who were made with equal pretensions to a share in all the advantages life can bestow. Savage nations oblige their women to a life

THE PASSIONS



DESIRE

FEAR

HOPE

SORROW

LOVE

RAGE

WEEPING

ADMIRATION

Taylor sculp.

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life of continual labour; upon them reſt all the drudgeries of domeſtic duty; while the huſband, indolently reclined in his hammock, is firſt ſerved from the fruits of her induſtry. From this negligent ſituation he is ſeldom rouzed, except by the calls of appetite, when it is neceſſary, either by fiſhing or hunting, to make a variety in his entertainments. A ſavage has no idea of taking pleaſure in exerciſe; he is ſurpriſed to ſee an European walk forward for his amuſement, and then return back again. As for his part, he could be contented to remain for ever in the ſame ſituation, perfectly ſatisfied with ſenſual pleaſures and undiſturbed repoſe. The women, of theſe countries, are the greateſt ſlaves upon earth; ſenſible of their weakneſs, and unable to reſiſt, they are obliged to ſuffer thoſe hardſhips which are naturally inflicted by ſuch as have been taught that nothing but corporeal force ought to give pre-eminence. It is not, therefore, till after ſome degree of refinement, that women are treated with lenity; and not till the higheſt degree of politeneſs, that they are permitted to ſhare in all the privileges of man. The firſt impulſe of ſavage nature is to confirm their ſlavery; the next, of half barbarous nations, is to appropriate their beauty; and that, of the perfectly polite, to engage their affections. In civilized countries, therefore, women have united the force of modeſty to the power of their natural charms; and thus obtain that ſuperiority over the mind, which they are unable to extort by their ſtrength.

When we come to treat of the different ſenſes, we ſhall be able to determine what ſtreſs is to be laid on the ideas of beauty in general, which we receive from the eyes. In the mean time, and that our deſcription of Man may not be found imperfect, let us examine the human countenance, as it appears among ourſelves, when agitated by the Paſſions.

DESIRE may be repreſented, by the eyebrows being preſſed and advanced over the eyes, which ſhall be more open than ordinary, with the eyeball in the middle full of fire; the noſtrils drawn cloſeſt next the eyes, the mouth alſo is more open, than in the foregoing action, the corners drawn back; the tongue may approach upon the edge of the lips, the colour more inflamed than in love; all theſe motions ſhewing the agitation of the ſoul cauſed by the ſpirits, which diſpoſe it to deſire a good, as convenient for it.

FEAR. But if there be no appearance of obtaining what we deſire, then inſtead of hope comes fear or deſpair; the motion of fear is expreſſed by the eyebrows a little raiſed next the noſe, the eyebrows ſparkling in an unquiet manner, ſituated in the middle of the eye; the mouth open, and drawn back, and more open at the corners than in the middle, having the under lip more drawn back than the upper; the complexion redder than in love or deſire, but not ſo beautifully inclined to livid, with the lips of the ſame colour, and dry when love changes fear into jealouſy.

HOPE. When there is an appearance of obtaining what we deſire, that brings forth hope: but the motions of this paſſion being not ſo much external as internal, we ſhall ſpeak but little of them, and only remark, that this paſſion keeps all the parts of the body ſuſpended, between fear and aſſurance; in ſuch a manner, that if one part of the eyebrow makes fear, the other makes ſecurity; and, in all the parts of the face and body, the motions of theſe two paſſions are particularly intermixed.

SORROW. As we have ſaid, that ſorrow is a diſagreeable faintneſs, by which the ſoul receives the inconveniency or defect, which preſents itſelf to it by the impreſſion of the brain; ſo this paſſion is repreſented, by motions which ſeem to mark the inquietude of the brain, and the dejection of the heart, the eyebrows being more raiſed in the middle of the forehead than next the temples. He that is troubled with this paſſion, has his eyeballs dull, the white of the eye inclining to yellow, the eyelids hanging down ſomething ſwoln, and a livid look round them; the noſtrils drawing downwards, the mouth open, the corners thereof drawn down; the head appears careleſsly hanging on one of the ſhoulders, the complexion of a kind of lead colour, and the lips pale and wan.

SIMPLE LOVE. The motions of this paſſion, when it is ſimple, are very ſoft and ſweet; for the forehead will be ſmooth, the eyebrows will be a little elevated over the place where the eyeballs ſhall be turned, the head inclined towards the object of the paſſion; the eyes may be moderately open, the white very lively and ſparkling, and the eyeball being greatly turned toward the object, will appear a little ſparkling and elevated; the noſe receives no alteration, nor any of the parts of the face, which being only filled with ſpirits that warm and enliven it, render the complexion freſh and lively, and particularly the cheeks and lips; the mouth may be a little open, the corner a little turned up, the lips will appear moiſt, and this moiſtneſs may be cauſed by vapours ariſing from the heart.

RAGE hath the ſame motions as deſpair, but yet more violent; for the face will be almoſt black, covered with a cold ſweat, the hair at an end, the eyes wandering in a contrary motion, the eyeballs ſometimes rolling towards the noſe, ſometimes back towards the ear, all the parts of the face will be extremely marked and ſwoln.

WEEPING. He that weeps, hath his eyebrows hanging down in the middle of the forehead, the eyes almoſt cloſed, very wet, and caſt down towards the cheeks; the noſtrils ſwelled, all the muſcles of the forehead being apparent; the mouth ſhall be half open, the corners hanging down, and making wrinkles in the cheek; the under lip will appear turned down and pouting out, all the face will appear drawn together and wrinkled, the colour very red, eſpecially about the eyes, eyebrows, noſe, mouth, and cheeks.

ADMIRATION. As we have ſaid, that admiration is the firſt and moſt temperate of all the paſſions, wherein the heart feels the leaſt diſturbance, ſo the face receives very little alteration; if any, it will be only in the raiſing of the eyebrows, the ends being parallel, the eye will be a little more open than ordinary, and the ball even between the lids, without motion, being fixed on the object which cauſes the admiration. The mouth will be open, but will appear without alteration, any more than the other parts of the face: this paſſion produces only a ſuſpenſion of motion, to give time to the ſoul to conſider what ſhe has to do; and to conſider attentively the object before her, if it be extraordinary. Out of this ſimple motion of admiration is engendered eſteem.

CHAP. VI.

Of SLEEP and HUNGER.

AS man, in all the privileges he enjoys, and the powers he is inveſted with, has a ſuperiority over all other animals, ſo, in his neceſſities, he ſeems inferior to the meaneſt of them all. Nature has brought him into life with a greater variety of wants and infirmities, than the reſt of her creatures, unarmed in the midſt of enemies. The lion has natural arms; the bear natural cloathing; but man is deſtitute of all ſuch advantages; and, from the ſuperiority of his mind alone, he is to ſupply

the deficiency. The number of his wants, however, were merely given, in order to multiply the number of his enjoyments; ſince the poſſibility of being deprived of any good, teaches him the value of its poſſeſſion. Were man born with thoſe advantages which he learns to poſſeſs by induſtry, he would very probably enjoy them with a blunter reliſh: it is by being naked, that he knows the value of a covering; it is by being expoſed to the weather that he learns the comforts of an habitation. Every want thus becomes a means of pleaſure, in the redreſſing; and the animal that has moſt deſires, may be ſaid to be capable of the greateſt variety of happineſs.

Beſides the thouſand imaginary wants peculiar to man, there are two, which he has in common with all other animals; and which he feels in a more neceſſary manner than they. Theſe are the wants of ſleep and hunger. Every animal that we are acquainted with, ſeems to endure the want of theſe with much leſs injury to health, than man; and ſome are moſt ſurpriſingly patient in ſuſtaining both. The little domeſtic animals that we keep about us, may often ſet a leſſen of calm reſignation, in ſupporting want and watchfulneſs, to the boaſted philoſopher. They receive their pittance at uncertain intervals, and wait its coming with chearful expectation. We have inſtances of the dog, and the cat, living, in this manner, without food for ſeveral days; and yet ſtill preſerving their attachment to the tyrant that oppreſſes them; ſtill ready to exert their little ſervices for his amuſement or defence. But the patience of theſe is nothing to what the animals of the foreſt endure. As theſe moſtly live upon accidental carnage, ſo they are often known to remain without food for ſeveral weeks together. Nature, kindly ſolicitous for their ſupport, has alſo contracted their ſtomachs, to ſuit them for their precarious way of living; and kindly, while it abridges the banquet, leſſens the neceſſity of providing for it. But the meaner tribes of animals are made ſtill more capable of ſuſtaining life without food, many of them remaining in a ſtate of torpid indifference till their prey approaches, when they jump upon and ſeize it. In this manner, the ſnake, or the ſpider, continue, for ſeveral months together, to ſubſiſt upon a ſingle meal; and ſome of the butterfly kinds live upon little or nothing. But it is very different with man: his wants daily make their importunate demands; and it is known, that he cannot continue to live many days without eating, drinking, and ſleeping.

Hunger is a much more powerful enemy to man than watchfulneſs, and kills him much ſooner. It may be conſidered as a diſorder that food removes; and that would quickly be fatal, without its proper antidote. In fact, it is ſo terrible to man, that to avoid it he would even encounter certain death; and, rather than endure its tortures, exchanges them for immediate deſtruction. However, by all accounts, it is much more dreadful in its approaches, than in its continuance; and the pains of a famiſhing wretch, decreaſe as his ſtrength diminiſhes. In the beginning, the deſire of food is dreadful indeed, as we know by experience, for there are few who have not in ſome degree felt its approaches. But, after the firſt or ſecond day, its tortures become leſs terrible, and a total inſenſibility at length come kindly in to the poor wretch's aſſiſtance. A captain of a ſhip, who was one of ſix that endured it in its extremities, was the only perſon that had not loſt his ſenſes, when they received accidental relief. His pains at firſt were ſo great, as to be often tempted to eat a part of one of the men who died; and which the reſt of his crew actually for ſome time lived upon: he ſaid that, during the countinuance of this paroxyſm, he found his pains inſupportable; and was deſirous, at one time, of anticipating that death which he thought inevitable: but his pains, he ſaid, gradually decreaſed, after the ſixth day, (for they had water in the ſhip, which kept them alive ſo long) and then he was in a ſtate rather of langour than deſire; nor did he much wiſh for food, except when he ſaw others eating; and that for a while revived his appetite, though with diminiſhed importunity. The latter part of the time, when his health was almoſt deſtroyed, a thouſand ſtrange images roſe upon his mind; and every one of his ſenſes began to bring him wrong information. The moſt fragrant perfumes appeared to him to have a fœtid ſmell; and every thing he looked at took a greeniſh hue, and ſometimes a yellow. When he was preſented with food by the ſhip's company that took him and his men up, four of whom died ſhortly after, he could not help looking upon it with loathing, inſtead of deſire; and it was not till after four days, that his ſtomach was brought to its natural tone; when the violence of his appetite returned, with a ſort of canine eagerneſs.

Thus dreadful are the effects of hunger; and yet, when we come to aſſign the cauſe that produces them, we find the ſubject involved in doubt and intricacy. This longing eagerneſs is, no doubt, given for a very obvious purpoſe; that of repleniſhing the body, waſted by fatigue and perſpiration. Were not men ſtimulated by ſuch a preſſing monitor, they might be apt to purſue other amuſements, with a perſeverance beyond their power; and forget the uſeful hours of refreſhment, in thoſe more tempting ones of pleaſure. But hunger makes a demand that will not be refuſed; and, indeed, the generality of mankind ſeldom await the call.

Hunger has been ſuppoſed by ſome to ariſe from the rubbing of the coats of the ſtomach againſt each other, without having any intervening ſubſtance to prevent their painful attrition. Others have imagined, that its juices, wanting their neceſſary ſupply, turn acrid, or, as ſome ſay, pungent; and thus fret its internal coats, ſo as to produce a train of the moſt uneaſy ſenſations. Boerhaave, who eſtabliſhed his reputation in phyſic, by uniting the conjectures of all thoſe that preceded him, aſcribes hunger to the united effect of both theſe cauſes; and aſſerts, that the pungency of the gaſtric juices, and the attrition of its coats againſt each other, cauſe thoſe pains, which nothing but food can remove. Theſe juices continuing ſtill to be ſeparated in the ſtomach, and every moment becoming more acrid, mix with the blood, and infect the circulation: the circulation being thus contaminated, becomes weaker, and more contracted; and the whole nervous frame ſympathiſing, an hectic fever and ſometimes madneſs is produced; in which ſtate the faint wretch expires. In this manner, the man who dies of hunger, may be ſaid to be poiſoned by the juices of his own body; and is deſtroyed leſs by the want of nouriſhment, than by the vitiated qualities of that which he had already taken.

However this may be, we have but few inſtances of men dying, except at ſea, of abſolute hunger; the decline of thoſe unhappy creatures who are deſtitute of food, at land, being more ſlow and unperceived. Theſe, from often being in need, and as often receiving an accidental ſupply, paſs their lives between ſurfeiting and repining; and their conſtitution is impaired by inſenſible degrees. Man is unfit for a ſtate of precarious expectation. That ſhare of provident precaution which incites him to lay up ſtores for a diſtant day, becomes his torment, when totally unprovided againſt an immediate call. The lower race of animals, when ſatisfied, for the inſtant moment, are perfectly happy: but

but it is otherwiſe with man; his mind anticipates diſtreſs, and feels the pangs of want even before it arreſts him. Thus the mind, being continually harraſſed by the ſituation, it at length influences the conſtitution, and unfits it for all its functions. Some cruel diſorder, but no way like hunger, ſeizes the unhappy ſufferer; ſo that almoſt all thoſe men who have thus long lived by chance, and whoſe every day may be conſidered as an happy eſcape from famine, are known at laſt to die in reality, of a diſorder cauſed by hunger; but which, in the common language, is often called a broken-heart. The number of ſuch as die in London for want, is much greater than one would imagine, about two thouſand in a year.

But how numerous ſoever thoſe who die of hunger may be, many times greater, on the other hand, are the number of thoſe who die by repletion. It is not the province of the preſent page to ſpeculate, with the phyſician, upon the danger of ſurfeits; or, with the moraliſt, upon the nauſeouſneſs of gluttony: it will only be proper to obſerve, that as nothing is ſo prejudicial to health as hunger by conſtraint, ſo nothing is more beneficial to the conſtitution than voluntary abſtinence. It was not without reaſon that religion enjoined this duty; ſince it anſwered the double purpoſe of reſtoring the health oppreſſed by luxury, and diminiſhed the conſumption of proviſions; ſo that a part might come to the poor. It ſhould be the buſineſs of the legiſlature, therefore, to enforce this divine precept; and thus, by reſtraining one part of mankind in the uſe of their ſuperfluities, to conſult for the benefit of thoſe who want the neceſſaries of life. The injunctions for abſtinence are ſtrict over the whole Continent; and were rigorouſly obſerved, even among ourſelves, for a long time after the Reformation. Queen Elizabeth, by giving her commands, upon this head, the air of a political injunction, leſſened, in a great meaſure, and very unwiſely, the religious force of the obligation. She enjoined that her ſubjects ſhould faſt from fleſh on Fridays and Saturdays; but at the ſame time declared, that this was not commanded from motives of religion, as if there were any differences in meats, but merely to favour the conſumption of fiſh, and thus to multiply the number of mariners; and alſo to ſpare the ſtock of ſheep, which might be more beneficial in another way. In this manner the injunction defeated its own force; and this moſt ſalutary law became no longer binding, when it was ſuppoſed to come purely from man. How far it may be enjoined in the Scriptures, we will not pretend to ſay; but this may be aſſerted, that if the utmoſt benefit to the individual, and the moſt extenſive advantage to ſociety, ſerve to mark any inſtitution as of Heaven, this of abſtinence may be reckoned among the foremoſt.

Were we to give an hiſtory of the various benefits that have ariſen from this command, and how conducive it has been to long life, the inſtances would fatigue with their multiplicity. It is ſurpriſing to what a great age the primitive Chriſtians of the Eaſt, who retired from perſecution in the deſerts of Arabia, continued to live in all the bloom of health, and yet all the rigours of abſtemious diſcipline. Their common allowance, as we are told, for four and twenty hours, was twelve ounces of bread, and nothing but water. On this ſimple beverage, St. Anthony is ſaid to have lived an hundred and five years; James, the hermit, an hundred and four; Arſenius, tutor to the emperor Arcadius, an hundred and twenty; St. Epiphanius, an hundred and fifteen; Simeon, an hundred and twelve; and Rombald, an hundred and twenty. In this manner did theſe holy temperate men live to an extreme old age, kept chearful by ſtrong hopes, and healthful by moderate labour.

Abſtinence which is thus voluntary, may be much more eaſily ſupported than conſtrained hunger. Man is ſaid to live without food for ſeven days; which is the uſual limit aſſigned him: and, perhaps, in a ſtate of conſtraint, this is the longeſt time he can ſurvive the want of it. But, in caſes of voluntary abſtinence, of ſickneſs, or ſleeping, he has been known to live much longer.

In the records of the Tower, there is an account of a Scotchman, impriſoned for felony, who, for the ſpace of ſix weeks, took not the leaſt ſuſtenance, being exactly watched during the whole time; and for this he received the king's pardon.

When the American Indians undertake long journies, and when, conſequently, a ſtock of proviſions ſufficient to ſupport them the whole way, would be more than they could carry, in order to obviate this inconvenience, inſtead of carrying the neceſſary quantity, they contrive a method of palliating their hunger, by ſwallowing pills, made of calcined ſhells and tobacco. Theſe pills take away all appetite, by producing a temporary diſorder in the ſtomach; and, no doubt, the frequent repetition of this wretched expedient, muſt at laſt be fatal. By theſe means, however, they continue ſeveral days without eating, chearfully bearing ſuch extremes of fatigue and watching, as would quickly deſtroy men bred up in a greater ſtate of delicacy. For thoſe arts by which we learn to obviate our neceſſities, do not fail to unfit us for their accidental encounter.

Upon the whole, therefore, man is leſs able to ſupport hunger than any other animal; and he is not better qualified to ſupport a ſtate of watchfulneſs. Indeed, ſleep ſeems much more neceſſary to him, than to any other creature; as, when awake, he may be ſaid to exhauſt a greater proportion of the nervous fluid; and, conſequently, to ſtand in need of an adequate ſupply. Other animals, when moſt awake, are but little removed from a ſtate of ſlumber; their feeble faculties, impriſoned in matter, and rather exerted by impulſe than deliberation, require ſleep rather as a ceſſation from motion, than from thinking. But it is otherwiſe with man; his ideas, fatigued with their various excurſions, demand a ceſſation, not leſs than the body, from toil; and he is the only creature that ſeems to require ſleep from double motives; not leſs for the refreſhment of the mental than of the bodily frame.

There are ſome lower animals, indeed, that ſeem to ſpend the greateſt part of their lives in ſleep; but, properly ſpeaking, the ſleep of ſuch may be conſidered as a kind of death; and their waking, a reſurrection. Flies, and inſects, are ſaid to be aſleep, at a time that all the vital motions have ceaſed; without reſpiration, without any circulation of their juices, if cut in pieces, they do not awake, nor does any fluid ooze out at the wound. Theſe may be conſidered rather as congealed than as ſleeping animals; and their reſt, during winter, rather as a ceſſation from life, than a neceſſary refreſhment: but in the higher races of animals, whoſe blood is not thus congealed, and thawed by heat, theſe all bear the want of ſleep much better than man; and ſome of them continue a long time without ſeeming to take any refreſhment from it whatſoever.

But man is more feeble; he requires its due return; and if it fails to pay the accuſtomed viſit, his whole frame is in a ſhort time thrown into diſorder: his appetite ceaſes; his ſpirits are dejected; his pulſe becomes quicker and harder; and his mind, abridged of its ſlumbering viſions, begins to adopt waking dreams. A thouſand ſtrange phantoms ariſe, which come and go without his will: theſe, which are tranſient in the beginning, at laſt take firm poſſeſſion of the mind, which yields to their dominion,

dominion, and after a long ſtruggle, runs into confirmed madneſs. In that horrid ſtate, the mind may be conſidered as a city without walls, open to every inſult, and paying homage to every invader: every idea that then ſtarts with any force, becomes a reality; and the reaſon, over fatigued with its former importunities, makes no head againſt the tyrannical invaſion, but ſubmits to it from mere imbecillity.

But it is happy for mankind, that this ſtate of inquietude is ſeldom driven to an extreme; and that there are medicines which ſeldom fail to give relief. However, man finds it more difficult than any other animal to procure ſleep: and ſome are obliged to court its approaches for ſeveral hours together, before they incline to reſt. It is in vain that all light is excluded; that all ſounds are removed; that warmth and ſoftneſs conſpire to invite it; the reſtleſs and buſy mind ſtill retains its former activity; and reaſon that wiſhes to lay down the reins, in ſpite of herſelf, is obliged to maintain them. In this diſagreeable ſtate, the mind paſſes from thought to thought, willing to loſe the diſtinctneſs of perception, by increaſing the multitude of images. At laſt, when the approaches of ſleep are near, every object of the imagination begins to mix with that next it; their outlines become, in a manner, rounder; a part of their diſtinctions fade away; and ſleep, that enſues, faſhions out a dream from the remainder.

If then it ſhould be aſked from what cauſe this ſtate of repoſe proceeds, or in what manner ſleep thus binds us for ſeveral hours together, we muſt fairly confeſs our ignorance, although it is eaſy to tell what philoſophers ſay upon the ſubject. Sleep, ſays one of them, conſiſts in a ſcarcity of ſpirits, by which the orifices or pores of the nerves in the brain, through which the ſpirits uſed to flow into the nerves, being no longer kept open by the frequency of the ſpirits, ſhut of themſelves; thus the nerves, wanting a new ſupply of ſpirits, become lax, and unfit to convey any impreſſion to the brain. All this, however, is explaining a very great obſcurity by ſomewhat more obſcure: leaving, therefore, thoſe ſpirits to open and ſhut the entrances to the brain, let us be contented with ſimply enumerating the effects of ſleep upon the human conſtitution.

In ſleep, the whole nervous frame is relaxed, while the heart and the lungs ſeem more forcibly exerted. This fuller circulation produces alſo a ſwelling of the muſcles, as they always find who ſleep with ligatures on any part of their body. This increaſed circulation alſo, may be conſidered as a kind of exerciſe, which is continued through the frame; and, by this, the perſpiration becomes more copious, although the appetite for food is entirely taken away. Too much ſleep dulls the apprehenſion, weakens the memory, and unfits the body for labour. On the contrary, ſleep too much abridged, emaciates the frame, produces melancholy, and conſumes the conſtitution. It requires ſome care, therefore, to regulate the quantity of ſleep, and juſt to take as much as will completely reſtore Nature, without oppreſſing it. The poor, as Otway ſays, ſleep little; forced, by their ſituation, to lengthen out their labour to their neceſſities, they have but a ſhort interval for this pleaſing refreſhment; and we are of opinion, that bodily labour demands a leſs quantity of ſleep than mental. Labourers and artizans are generally ſatisfied with about ſeven hours; but we have known ſome ſcholars who uſually ſlept nine, and perceived their faculties no way impaired by over-ſleeping.

The famous Philip Barrettiere, who was conſidered as a prodigy of learning at the age of fourteen, was known to ſleep regularly twelve hours in the twenty-four; the extreme activity of his mind, when awake, in ſome meaſure called for an adequate alternation of repoſe: and, we are apt to think, that when ſtudents ſtint themſelves in this particular, they leſſen the waking powers of the imagination, and weaken its moſt ſtrenuous exertions. Animals, that ſeldom think, as was ſaid, can very eaſily diſpenſe with ſleep; and of men, ſuch as think leaſt, will very probably be ſatisfied with the ſmalleſt ſhare. A life of ſtudy, it is well known, unfits the body for receiving this gentle refreſhment; the approaches of ſleep are driven off by thinking: when, therefore, it comes at laſt, we ſhould not be too ready to interrupt its continuance.

Sleep is, indeed, to ſome, a very agreeable period of their exiſtence: and it has been a queſtion in the ſchools, which was moſt happy, the man who was a beggar by night, and a king by day; or he was a beggar by day, and a king by night? It is given in favour of the nightly monarch, by him who firſt ſtarted the queſtion: for the dream, ſays he, gives the full enjoyment of the dignity, without its attendant inconveniencies; while, on the other hand, the king, who ſuppoſes himſelf degraded, feels all the miſery of his fallen fortune, without trying to find the comforts of his humble ſituation. Thus, by day, both ſtates have their peculiar diſtreſſes: but, by night, the exalted beggar is perfectly bleſſed, and the king completely miſerable. All this, however, is rather fanciful than juſt; the pleaſure dreams can give us, ſeldom reaches to our waking pitch of happineſs: the mind often, in the midſt of its higheſt viſionary ſatisfactions, demands of itſelf, whether it does not owe them to a dream; and frequently awakes with the reply.

But it is ſeldom, except in caſes of the higheſt delight, or the moſt extreme uneaſineſs, that the mind has power thus to diſengage itſelf from the dominion of fancy. In the ordinary courſe of its operations, it ſubmits to thoſe numberleſs fantaſtic images that ſucceed each other; and which, like many of our waking thoughts, are generally forgotten. Of theſe, however, if any, by their oddity, or their continuance, affect us ſtrongly, they are then remembered; and there have been ſome who felt their impreſſions ſo ſtrongly, as to miſtake them for realities, and to rank them among the paſt actions of their lives.

There are others, upon whom dreams ſeem to have a very different effect; and who, without ſeeming to remember their impreſſions the next morning, have yet ſhewn, by their actions during ſleep, that they were very powerfully impelled by their dominion. We have numberleſs inſtances of ſuch perſons, who, while aſleep, have performed many of the ordinary duties to which they had been accuſtomed when waking; and with a ridiculous induſtry, have completed by night, what they failed doing by day. We are told, in the German ephemerides, of a young ſtudent, who being enjoined a ſevere exerciſe by his tutor, went to bed, deſpairing of accompliſhing it. The next morning, awaking, to his great ſurprize he found the taſk fairly written out, and finiſhed in his own hand-writing. He was, at firſt, as the account has it, induced to aſcribe this ſtrange production to the operations of an infernal agent; but his tutor, willing to examine the affair to the bottom, ſet him another exerciſe, ſtill more ſevere than the former; and took precautions to obſerve his conduct the whole night. The young gentleman, upon being ſo ſeverely taſked, felt the ſame inquietude that he had done on the former occaſion; went to bed gloomy and penſive, pondering on the next day's duty, and, after ſome time, fell aſleep. But ſhortly after, his tutor, who continued to obſerve him from a place that was concealed, was ſurpriſed to ſee him

him get up, and very deliberately go to the table; there he took out pen, ink, and paper, drew himself a chair, and sate very methodically to thinking: it seems, that his being asleep only served to strengthen the powers of his imagination; for he very quickly and easily went through the task assigned him, put his chair aside, and then returned to bed to take out the rest of his nap. What credit we are to give to this account, we will not pretend to determine: but this may be said, that the book from whence it is taken, has some good marks of veracity; for it is very learned, and very dull, and is written in a country noted, if not for truth, at least for want of invention.

The ridiculous history of Arlotto is well known, who has had a volume written, containing a narrative of the actions of his life, not one of which was performed while he was awake. He was an Italian Franciscan friar, extremely rigid in his manners, and remarkably devout and learned in his daily conversation. By night, however, and during his sleep, he played a very different character from what he did by day, and was often detected in very atrocious crimes. He was at one time detected in actually attempting a rape, and did not awake till the next morning, when he was surprised to find himself in the hands of justice. His brothers of the convent often watched him while he went very deliberately into the chapel, and there attempted to commit sacrilege. They sometimes permitted him to carry the chalice and the vestments away into his own chamber, and the next morning amused themselves at the poor man's consternation for what he had done. But of all his sleeping transgressions, that was the most ridiculous, in which he was called to pray for the soul of a person departed. Arlotto, after having very devoutly performed his duty, retired to a chamber which was shewn him, to rest; but there he had no sooner fallen asleep, than he began to reflect that the dead body had got a ring upon one of the fingers, which might be useful to him: accordingly, with a pious resolution of stealing it, he went down, undressed as he was, in a room full of women, and, with great composure, endeavoured to seize the ring. The consequence was, that he was taken before the inquisition for witchcraft, and the poor creature had like to have been condemned, till his peculiar character accidentally came to be known: however, he was ordered to remain for the rest of life in his own convent, and upon no account whatsoever to stir abroad.

What are we to say to such actions as these; or how account for this operation of the mind in dreaming? It should seem, that the imagination, by day, as well as by night, is always employed; and that often, against our wills, it intrudes where it is least commanded or desired. While awake, and in health, this busy principle cannot much delude us: it may build castles in the air, and raise a thousand phantoms before us; but we have every one of the senses alive, to bear testimony to its falsehood. Our eyes shew us that the prospect is not present; our hearing, and our touch, depose against its reality; and our taste and smelling are equally vigilant in detecting the impostor. Reason, therefore, as soon as gives judgment upon the cause; and the vagrant intruder, imagination, is imprisoned, or banished from the mind. But in sleep it is otherwise, having, as much as possible, put our senses from their duty, having closed the eyes from seeing, and the ears, taste, and smelling, from their peculiar functions, and having diminished even the touch itself, by all the arts of softness, the imagination is then left to act at large, and to lead the understanding without an opposer. Every incursive idea then becomes a reality; and the mind, not having one power that can prove the illusion, takes them for truths. As in madness, the senses, from struggling with the imagination, are at length forced to submit, so, in sleep, they seem for a while soothed into the like submission: the smallest violence exerted upon any one of them, however, rouzes all the rest in their mutual defence; and the imagination, that had for a while told its thousand falsehoods, is totally driven away, or only permitted to pass under the custody of such as are every moment ready to detect its imposition.

Vide p. 56.

CHAP. VII.

Of SEEING.

HAVING mentioned the senses as correcting the errors of the imagination, and as forcing it, in some measure, to bring us just information, it will naturally follow that we should examine the nature of those senses themselves: we shall thus be enabled to see how far they also impose on us, and how far they contribute to correct each other. Let it be observed, however, that in this we are neither giving a treatise of optics, or phonics, but an history of our own perceptions; and to those we chiefly confine ourselves.

The eyes very soon begin to be formed in the human embryo, and in the chicken also. Of all the parts which the animal has double, the eyes are produced the soonest, and appear the most prominent. It is true, indeed, that in viviparous animals, and particularly in man, they are not so large in proportion, at first, as in the oviparous kinds; nevertheless, they are more speedily developed, when they begin to appear, than any other parts of the body. It is the same with the organ of hearing; the little bones that compose the internal parts of the ear, are entirely formed before the other bones, though much larger, have acquired any part of their growth, or solidity. Hence it appears, that those parts of the body which are furnished with the greatest quantity of the nerves, are the first in forming. Thus the brain, and the spinal marrow, are the first seen begun in the embryo; and in general, it may be said, that wherever the nerves go, or send their branches in great numbers, there the parts are soonest begun, and the most completely finished.

If we examine the eyes of a child some hours, or even some days after its birth, it will be easily discerned that it, as yet, makes no use of them. The humours of the organ not having acquired a sufficient consistence, the rays of light strike but confusedly upon the retina, or expansion of nerves at the back of the eye. It is not till about a month after they are born, that children fix them upon objects; for, before that time, they turn them indiscrimmately every where, without appearing to be affected by any. At six, or seven weeks old, they plainly discover a choice in the objects of their attention; they fix their eyes upon the most brilliant colours, and seem peculiarly desirous of turning them towards the light. Hitherto, however, they only seem to fortify the organ for seeing distinctly; but they have still many illusions to correct.

The first great error in vision is, that the eye inverts every object; and it in reality appears to the child, until the touch has served to undeceive it, turned upside down. A second error in vision is, that every object appears double. The same object forms itself distinctly upon each eye; and is consequently seen twice. This error, also, can only be corrected by the touch; and although, in reality, every object we see appears inverted, and double, yet the judgment, and habit, have so often corrected the sense, that we no longer submit to its im-

position, but ſee every object in its juſt poſition, the very inſtant it appears. Were we, therefore, deprived of feeling, our eyes would not only miſrepreſent the ſituation, but alſo the number of all things round us.

To convince us that we ſee objects inverted, we have only to obſerve the manner in which images are repreſented, coming through a ſmall hole, in a darkened room. If ſuch a ſmall hole be made in a dark room ſo that no light can come in, but through it, all the objects without will be painted on the wall behind, but in an inverted poſition, their heads downwards. For as all the rays which paſs from the different parts of the object without, cannot enter the hole in the ſame extent which they had in leaving the object, ſince, if ſo, they would require the aperture to be as large as the object; and, as each part, and every point of the object, ſends forth the image of itſelf on every ſide, and the rays, which form theſe images, paſs from all points of the object as from ſo many centres; ſo ſuch only can paſs through the ſmall aperture as come in oppoſite directions. Thus the little aperture becomes a centre for the entire object; through which the rays from the upper parts, as well as from the lower parts of it, paſs in converging directions; and, conſequently, they muſt croſs each other in the central point, and thus paint the objects behind, upon the wall, in an inverted poſition.

It is, in like manner, eaſy to conceive, that we ſee all objects double, whatever our preſent ſenſations may ſeem to tell us to the contrary. For, to convince us of this, we have only to compare the ſituation of any one object on ſhutting one eye, and then compare the ſame ſituation by ſhutting the other. If, for inſtance, we hold up a finger, and ſhut the right eye, we ſhall find it hide a certain part of the room; if again reſhutting the other eye, we ſhall find that part of the room viſible, and the finger ſeeming to cover a part of the room that had been viſible before. If we open both eyes, however, the part covered will appear to lie between the two extremes. But, the truth is, we ſee the object our finger had covered, one image of it to the right, and the other to the left; but, from habit, ſuppoſe that we ſee but one image placed between both; our ſenſe of feeling having corrected the errors of ſight. And thus, alſo, if inſtead of two eyes we had two hundred, we ſhould, at firſt, fancy the objects increaſed in proportion, until one ſenſe had corrected the errors of another.

The having two eyes might thus be ſaid to be rather an inconvenience than a benefit, ſince one eye would anſwer the purpoſes of ſight as well, and be leſs liable to illuſion. But it is otherwiſe; two eyes greatly contribute, if not to diſtinct, at leaſt to extenſive viſion. When an object is placed at a moderate diſtance, by the means of both eyes we ſee a larger ſhare of it than we poſſibly could with one; the right eye ſeeing a greater portion of its right ſide, and the left eye of its correſpondent ſide. Thus both eyes, in ſome meaſure, ſee round the object; and it is this that gives it, in nature, that bold relievo, or ſwelling, with which they appear; and which no painting, how exquiſite ſoever, can attain to. The painter muſt be contented with ſhading on a flat ſurface; but the eyes, in obſerving nature, do not behold the ſhading only, but a part of the figure alſo, that lies behind theſe very ſhadings, which gives it that ſwelling, which painters ſo ardently deſire, but can never fully imitate.

There is another defect, which either of the eyes, taken ſingly, would have, but which is corrected, by having the organ double. In either eye there is a point, which has no viſion whatſoever; ſo that if one of them only is employed in ſeeing, there is a part of the object to which it is always totally blind. This is that part of the optic nerve where its vein and artery run; which being inſenſible, that point of the object that is painted there muſt continue unſeen. To be convinced of this we have only to try a very eaſy experiment. If we take three black patches, and ſtick them upon a white wall, about a foot diſtant from each other, each about as high as the eye that is to obſerve them; then retiring ſix or ſeven feet back, and ſhutting one eye, by trying for ſome time we ſhall find, that while we diſtinctly behold the black ſpots that are to the right and left, that which is in the middle remains totally unſeen. Or, in other words, when we bring that part of the eye, where the optic artery runs, to fall upon the object, it will then become inviſible. This defect, however, in either eye, is always corrected by both, ſince the part of the object that is unſeen by one, will be very diſtinctly perceived by the other.

Beſide the former defects we can have no idea of diſtances from the ſight, without the help of touch. Naturally every object we ſee appears to be within our eyes; and a child, who has as yet made but little uſe of the ſenſe of feeling, muſt ſuppoſe that every thing it ſees makes a part of itſelf. Such objects are only ſeen more or leſs bulky as they approach or recede from its eyes; ſo that a fly that is near will appear larger than an ox at a diſtance. It is experience alone that can rectify this miſtake; and a long acquaintance with the real ſize of every object, quickly aſſures us of the diſtance at which it is ſeen. The laſt man in a file of ſoldiers appears in reality much leſs, perhaps ten times more diminutive, than the man next to us; however, we do not perceive this difference, but continue to think him of equal ſtature; for the numbers we have ſeen thus leſſened by diſtance, and have found, by repeated experience, to be of the natural ſize, when we come cloſer, inſtantly corrects the ſenſe, and every object is perceived with nearly its natural proportion. But it is otherwiſe, if we obſerve objects in ſuch ſituations as we have not had ſufficient experience to correct the errors of the eye; if, for inſtance, we look at men from the top of an high ſteeple, they, in that caſe appear very much diminiſhed, as we have not had an habit of correcting the ſenſe in that poſition.

Although a ſmall degree of reflection will ſerve to convince us of the truth of theſe poſitions, it may not be amiſs to ſtrengthen them by an authority which cannot be diſputed. Mr. Cheſelden having couched a boy of thirteen for a cataract, who had hitherto been blind, and thus at once having reſtored him to ſight, curiouſly marked the progreſs of his mind, upon that occaſion. This youth, though he had been till then incapable of ſeeing, yet was not totally blind, but could tell day from night, as perſons in his ſituation always may. He could alſo, with a ſtrong light, diſtinguiſh black from white, and either from the vivid colour of ſcarlet; however, he ſaw nothing of the form of bodies; and, without a bright light, not even colours themſelves. He was, at firſt, couched only in one of his eyes; and, when he ſaw for the firſt time, he was ſo far from judging of diſtances, that he ſuppoſed his eyes touched every object that he ſaw, in the ſame manner as his hands might be ſaid to feel them. The objects that were moſt agreeable to him were ſuch as were of plain ſurfaces and regular figures; though he could as yet make no judgment whatever of their different forms, nor give a reaſon why one pleaſed him more than another. Although he could form ſome idea of colours during his ſtate of blindneſs, yet that was not ſufficient to direct him at preſent; and he could ſcarcely be perſuaded that the colours he now ſaw were the ſame with thoſe he had formerly conceived ſuch erroneous ideas of. He delighted moſt in green; but black objects, as if giving

ing him an idea of his former blindneſs, he regarded with horror. He had, as was ſaid, no idea of forms; and was unable to diſtinguiſh one object from another, though never ſo different. When thoſe things were ſhown him, which he had been formerly familiarized to, by his feeling, he beheld them with earneſtneſs, in order to remember them a ſecond time; but, as he had too many to recollect at once, he forgot the greateſt number; and for one he could tell, after ſeeing, there was a thouſand he was totally unacquainted with. He was very much ſurpriſed to find that thoſe things and perſons he loved beſt were not the moſt beautiful to be ſeen; and even teſtified diſpleaſure in not finding his parents ſo handſome as he conceived them to be. It was near two months before he could find that a picture reſembled a ſolid body. Till then he only conſidered it as a flat ſurface, variouſly ſhadowed; but, when he began to perceive that theſe kind of ſhadings actually repreſented human beings, he then began to examine, by his touch, whether they had not the uſual qualities of ſuch bodies, and was greatly ſurpriſed to find, what he expected a very unequal ſurface to be ſmooth and even. He was then ſhewn a miniature picture of his father, which was contained in his mother's watch-caſe, and he readily perceived the reſemblance; but aſked, with great aſtoniſhment, how ſo large a face could be contained in ſo ſmall a compaſs? It ſeemed as ſtrange to him as if a buſhel was contained in a pint veſſel. At firſt, he could bear but a very ſmall quantity of light, and he ſaw every object much greater than the life; but in proportion as he ſaw objects that were really large, he ſeemed to think the former were diminiſhed; and although he knew the chamber where he was contained in the houſe, yet until he ſaw the latter, he could not be brought to conceive how an houſe could be larger than a chamber. Before the operation he had no great expectations from the pleaſure he ſhould receive from a new ſenſe; he was only excited by the hopes of being able to read and write; he ſaid, for inſtance, that he could have no greater pleaſure in walking, in the garden, with his ſight than he had without it, for he walked there at his eaſe, and was acquainted with all the walks. He remarked alſo, with great juſtice, that his former blindneſs gave him one advantage over the reſt of mankind, which was that of being able to walk in the night, with confidence and ſecurity. But, when he began to make uſe of his new ſenſe, he ſeemed tranſported beyond meaſure. He ſaid that every new object was a new ſource of delight, and that his pleaſure was ſo great as to be paſt expreſſion. About a year after, he was brought to Epſom, where there is a very fine proſpect, with which he ſeemed greatly charmed, and he called the landſcape before him a new method of ſeeing. He was couched in the other eye, a year after the former, and the operation ſucceeded equally well: when he ſaw with both eyes, he ſaid that objects appeared to him twice as large as when he ſaw but with one; however, he did not ſee them doubled, or at leaſt he ſhewed no marks as if he ſaw them ſo. Mr. Cheſelden mentions inſtances of many more that were reſtored to ſight in this manner; they all ſeemed to concur in their perceptions with this youth, and they all ſeemed particularly embarraſſed in learning how to direct their eyes to the objects they wiſhed to obſerve.

In this manner it is that our feeling corrects the ſenſe of ſeeing, and that objects which appear of very different ſizes, at different diſtances, are all reduced, by experience, to their natural ſtandard. But not the feeling only, but alſo the colour, and brightneſs of the object, contributes, in ſome meaſure, to aſſiſt us in forming an idea of the diſtance at which it appears. Thoſe which we ſee moſt ſtrongly marked with light and ſhade, we readily know to be nearer than thoſe on which the colours are more faintly ſpread, and that, in ſome meaſure, take a part of their hue from the air between us and them. Bright objects alſo, are ſeen at a greater diſtance than ſuch as are obſcure, and, moſt probably, for this reaſon, that, being leſs ſimilar in colour to the air which interpoſes, their impreſſions are leſs effaced by it, and they continue more diſtinctly viſible. Thus a black and diſtant object is not ſeen ſo far off as a bright and glittering one; and a fire by night is ſeen much farther off than by day.

The power of ſeeing objects at a diſtance is very rarely equal in both eyes. When this inequality is in any great degree, the perſon ſo circumſtanced then makes uſe only of one eye, ſhutting that which ſees the leaſt, and employing the other with all its power. And hence proceeds that aukward look which is known by the name of ſtrabiſm.

There are many reaſons to induce us to think that ſuch as are near-ſighted ſee objects larger than other perſons; and yet the contrary is moſt certainly true, for they ſee them leſs. Mr. Buffon informs us that he himſelf is ſhort-ſighted, and that his left eye is ſtronger than his right. He has very frequently experienced, upon looking at any object, ſuch as the letters of a book, that they appear leſs to the weakeſt eye; and that when he places the book, ſo as that the letters appear double, the images of the left eye, which is ſtrongeſt, are greater than thoſe of the right, which is the moſt feeble. He has examined ſeveral others, who were in ſimilar circumſtances, and has always found that the beſt eye ſaw every object the largeſt. This he aſcribes to habit; for near-ſighted people being accuſtomed to come cloſe to the object, and view but a ſmall part of it at a time, the habit enſues, when the whole of an object is ſeen, and it appears leſs to them than to others.

Infants having their eyes leſs than thoſe of adults, muſt ſee objects alſo ſmaller in proportion. For the image formed on the back of the eye will be large, as the eye is capacious; and infants, having it not ſo great, cannot have ſo large a picture of the object. This may be a reaſon alſo why they are unable to ſee ſo diſtinctly, or at ſuch diſtances as perſons arrived at maturity.

Old men, on the contrary, ſee bodies cloſe to them very indiſtinctly, but bodies at a great diſtance from them with more preciſion; and this may happen from an alteration in the coats, or, perhaps, humours of the eye; and not, as is ſuppoſed, from their diminution. The cornea, for inſtance, may become too rigid to adapt itſelf, and take a proper convexity for ſeeing minute objects; and its very flatneſs will be ſufficient to fit it for diſtant viſion.

When we caſt our eyes upon an object extremely brilliant, or when we fix and detain them too long upon the ſame object, the organ is hurt and fatigued, its viſion becomes indiſtinct, and the image of the body, which has thus too violently, or too perſeveringly employed us, is painted upon every thing we look at, and mixes with every object that occurs. And this is an obvious conſequence of the eye taking in too much light, either immediately, or by reflection. Every body expoſed to the light, for a time, drinks in a quantity of its rays, which, being brought into darkneſs, it cannot inſtantly diſcharge. Thus the hand, if it be expoſed to broad day-light, for ſome time, and then immediately ſnatched into a dark room, will appear ſtill luminous; and it will be ſome time before it is totally darkened. It is thus with the eye, which, either by an inſtant gaze at the ſun, or a ſteady continuance, upon ſome leſs brilliant object, has taken in too much light; its humours are, for a while,

unfit

unfit for viſion, until that be diſcharged, and room made for rays of a mild nature. How dangerous the looking upon bright and luminous objects is to the ſight, may be eaſily ſeen, from ſuch as live in countries, covered for moſt part of the year with ſnow, who become generally blind before their time. Travellers who croſs theſe countries, are obliged to wear a crape before their eyes, to ſave them, which would otherwiſe be rendered totally unſerviceable; and it is equally dangerous in the ſandy plains of Africa. The reflection of the light is there ſo ſtrong that it is impoſſible to ſuſtain the effect, without incurring the danger of loſing one's ſight entirely. Such perſons, therefore, as read, or write for any continuance, ſhould chuſe a moderate light, in order to ſave their eyes; and, although it may ſeem inſufficient at firſt, the eye will accuſtom itſelf to the ſhade, by degrees, and be leſs hurt by the want of light than the exceſs.

It is, indeed, ſurpriſing how far the eye can accommodate itſelf to darkneſs, and make the beſt of a gloomy ſituation. When firſt taken from the light, and brought into a dark room, all things diſappear; or, if any thing is ſeen, it is only the remaining radiations that ſtill continue in the eye. But, after a very little time, when theſe are ſpent, the eye takes the advantage of the ſmalleſt ray that happens to enter; and this alone would, in time, ſerve for many of the purpoſes of life. There was a gentleman of great courage and underſtanding, who was a major under King Charles the Firſt. This unfortunate man ſharing in his maſter's misfortunes, and being forced abroad, ventured at Madrid to do his king a ſignal ſervice; but, unluckily, failed in the attempt. In conſequence of this, he was inſtantly ordered to a dark and diſmal dungeon, into which the light never entered, and into which there was no opening but by an hole at the top, down which the keeper put his proviſions, and preſently cloſed it again on the other ſide. In this manner the unfortunate loyaliſt continued for ſome weeks, diſtreſſed and diſconſolate; but, at laſt, began to think he ſaw ſome little glimmering of light. This internal dawn ſeemed to increaſe from time to time, ſo that he could not only diſcover the parts of his bed, and ſuch other large objects, but, at length, he even began to perceive the mice that frequented his cell; and ſaw them as they ran about the floor, eating the crumbs of bread that happened to fall. After ſome months confinement he was at laſt ſet free; but, ſuch was the effect of the darkneſs upon him, that he could not for ſome days venture to leave his dungeon, but was obliged to accuſtom himſelf by degrees to the light of the day.

CHAP. VIII.

Of HEARING.

AS the ſenſe of hearing, as well as of ſight, gives us notice of remote objects, ſo like that, it is ſubject to ſimilar errors, being capable of impoſing on us upon all occaſions, where we cannot rectify it by the ſenſe of feeling. We can have from it no diſtinct intelligence of the diſtance from whence a ſounding body is heard; a great noiſe far off, and a ſmall one very near, produces the ſame ſenſation; and, unleſs we receive information from ſome other ſenſe, we can never diſtinctly tell whether the ſound be a great or a ſmall one. It is not till we have learned, by experience, that the particular ſound which is heard, is of a peculiar kind, then we can judge of the diſtance from whence we hear it. When we know the tone of the bell, we can then judge how far it is from us.

Every body that ſtrikes againſt another produces a ſound, which is ſimple, and but one in bodies which are not elaſtic, but which is often repeated in ſuch as are. If we ſtrike a bell, or a ſtretched ſtring, for inſtance, which are both elaſtic, a ſingle blow produces a ſound, which is repeated by the undulations of the ſonorous body, and which is multiplied as often as it happens to undulate, or vibrate. Theſe undulations each ſtrike their own peculiar blow; but they ſucceed ſo faſt, one behind the other, that the ear ſuppoſes them one continued ſound; whereas in reality, they make many. A perſon who ſhould, for the firſt time, hear the toll of the bell, would very probably, be able to diſtinguiſh theſe breaks of ſound; and, in fact, we can readily ourſelves perceive an intenſion and remiſſion in the ſound.

In this manner, ſounding bodies are of two kinds; thoſe unelaſtic ones, which being ſtruck, return but a ſingle ſound; and thoſe more elaſtic returning a ſucceſſion of ſound, which uniting together form a tone. This tone may be conſidered as a great number of ſounds, all produced one after the other, by the ſame body, as we find in a bell, or the ſtring of an harpſichord, which continues to ſound for ſome time after it is ſtruck. A continuing tone may be alſo produced from a nonelaſtic body, by repeating the blow quick and often, as when we beat a drum, or when we draw a bow along the ſtring of a fiddle.

Conſidering the ſubject in this light, if we ſhould multiply the number of blows, or repeat them at quicker intervals upon the ſounding body, as upon the drum, for inſtance, it is evident that this will have no effect in altering the tone; it will only make it either more even or more diſtinct. But it is otherwiſe, if we increaſe the force of the blow; if we ſtrike the body with double weight, this will produce a tone twice as loud as the former. If, for inſtance, we ſtrike a table with a ſwitch, this will be very different from the ſound produced by ſtriking it with a cudgel. From hence, therefore, we may infer, that all bodies give a louder and graver tone, not in proportion to the number of times they are ſtruck, but in proportion to the force that ſtrikes them. And, if this be ſo, thoſe philoſophers who make the tone of a ſonorous body, of a bell, or the ſtring of an harpſichord, for inſtance, to depend upon the number only of its vibrations, and not the force, have miſtaken what is only an effect for a cauſe. A bell, or an elaſtic ſtring can only be conſidered as a drum beaten; and the frequency of the blows can make no alteration whatever in the tone. The largeſt bells, and the longeſt and thickeſt ſtrings, have the moſt forceful vibrations; and, therefore, their tones are the moſt loud and the moſt grave.

To know the manner in which ſounds thus produced become pleaſing, it muſt be obſerved, no one continuing tone, how loud or ſwelling ſoever, can give us ſatisfaction; we muſt have a ſucceſſion of them, and thoſe in the moſt pleaſing proportion. The nature of this proportion may be thus conceived. If we ſtrike a body incapable of vibration with a double force, or, what amounts to the ſame thing, with a double maſs of matter, it will produce a ſound that will be doubly grave. Muſic has been ſaid, by the ancients, to have been firſt invented from the blows of different hammers on an anvil. Suppoſe then we ſtrike an anvil with a hammer of one pound weight, and again with an hammer of two pounds, it is plain that the two pound hammer will produce a ſound twice as grave as the former. But if we ſtrike with a two pound hammer, and then with a three pound, it is evident that the latter will produce a ſound one third more grave than the former. If we ſtrike an anvil with a three pound hammer, and then with a four pound,

it will likewiſe follow that the latter will be a quarter part more grave than the former. Now, in the comparing between all thoſe ſounds, it is obvious that the difference between one and two is more eaſily perceived than between two and three, three and four, or any numbers ſucceeding in the ſame proportion. The ſucceſſion of ſounds will be, therefore, pleaſing in proportion to the eaſe with which they may be diſtinguiſhed. That ſound which is double the former, or, in other words, the octave to the preceding tone, will of all others be the moſt pleaſing. The next to that, which is as two to three, or, in other words, the third, will be moſt agreeable. And thus univerſally, thoſe ſounds whoſe difference may be moſt eaſily compared are the moſt agreeable.

Muſicians, therefore, have contented themſelves with ſeven different proportions of ſound, which are called notes, and which ſufficiently anſwer all the purpoſes of pleaſure. Not but that they might adopt a greater diverſity of proportions; and ſome have actually done ſo; but, in theſe, the differences of the proportion are ſo imperceptible, that the ear is rather fatigued than pleaſed in making the diſtinction. In order, however, to give variety, they have admitted half tones; but, in all the countries where muſic is yet in its infancy, they have rejected ſuch; and they can find muſic in none but the obvious. The Chineſe, for inſtance, have neither flats nor ſharps in their muſic; but the intervals between their other notes, are in the ſame proportion with ours.

Many more barbarous nations have their peculiar inſtruments of muſic; and, what is remarkable, the proportion between their notes is in all the ſame as in ours. This is not the place for entering into the nature of theſe ſounds, their effects upon the air, or their conſonances with each other. We are not now giving an hiſtory of ſound, but of human perception.

All countries are pleaſed with muſic; and, if they have not ſkill enough to produce harmony, at leaſt they ſeem willing to ſubſtitute noiſe. Without all queſtion, noiſe alone is ſufficient to operate powerfully on the ſpirits; and, if the mind be already prediſpoſed to joy, we have ſeldom found noiſe fail of increaſing it into rapture. The mind feels a kind of diſtracted pleaſure in ſuch powerful ſounds, braces up every nerve, and riots in the exceſs. But, as in the eye, an immediate gaze upon the ſun will diſturb the organ, ſo, in the ear, a loud, unexpected noiſe, diſorders the whole frame, and ſometimes diſturbs the ſenſe ever after. The mind muſt have time to prepare for the expected ſhock, and to give its organs the proper tenſion for its arrival.

Muſical ſounds, however, ſeem of a different kind. Theſe are generally moſt pleaſing, which are moſt unexpected. It is not from bracing up the nerves, but from the grateful ſucceſſion of the ſounds, that theſe become ſo charming. There are few, how indifferent ſoever, but have at times felt their pleaſing impreſſion; and, perhaps, even thoſe who have ſtood out againſt the powerful perſuaſion of ſounds, only wanted the proper tune, or the proper inſtrument to allure them.

The ancients give us a thouſand ſtrange inſtances of the effects of muſic, upon men and animals. The ſtory of Arion's harp, that gathered the dolphins to the ſhip's ſide, is well known; and, what is remarkable, Schotteus aſſures us, that he ſaw a ſimilar inſtance of fiſhes being allured by muſic. They tell us of diſeaſes that have been cured, unchaſtity corrected, ſeditions quelled, paſſions removed, and ſometimes excited even to madneſs. Doctor Wallis has endeavoured to account for theſe ſurpriſing effects, by aſcribing them to the novelty of the art; but we can ſcarce heſitate to impute them to the exaggeration of their writers. They are as hyperbolical in the effects of their oratory; and yet, we well know, there is nothing in the orations which they have left us, capable of exciting madneſs, or of raſing the mind to that ungovernable degree of fury which they deſcribe. As they have exaggerated, therefore, in one inſtance, we may naturally ſuppoſe, that they have done the ſame in the other: and, indeed, from the few remains we have of their muſic, collected by Meibomius, one might be apt to ſuppoſe, there was nothing very powerful in what is loſt. Nor does any one of the ancient inſtruments, ſuch as we ſee them repreſented in ſtatues, appear comparable to our fiddle.

However this be, we have many odd accounts, not only among them, but the moderns, of the power of muſic; and it muſt not be denied, but that, on ſome particular occaſions, muſical ſounds may have a very powerful effect. We have ſeen all the horſes and cows in a field, where there were above an hundred, gather round a perſon that was blowing the French horn, and ſeeming to teſtify an aukward kind of ſatisfaction. Dogs are well known to be very ſenſible of different tones in muſic; and we have ſometimes heard them ſuſtain a very ridiculous part in a concert, where their aſſiſtance was neither expected nor deſired.

We are told, of Henry IV. of Denmark, that being one day deſirous of trying in perſon whether a muſician who boaſted that he could excite men to madneſs, was not an impoſtor, he ſubmitted to the operation of his ſkill: but the conſequence was much more terrible than he expected; for, becoming actually mad, he killed four of his attendants in the midſt of his tranſports. A contrary effect of muſic we have, in the cure of a madman of Alais, in France, by muſic. This man, who was a dancing-maſter, after a fever of five days grew furious, and ſo ungovernable that his hands were obliged to be tied to his ſides: what at firſt was rage, in a ſhort time was converted into ſilent melancholy, which no arts could exhilarate, nor no medicines remove. In this ſullen and dejected ſtate, an old acquaintance accidentally came to enquire after his health; he found him ſitting up in bed, tied, and totally regardleſs of every external object round him. Happening, however, to take up a fiddle that lay in the room, and touching a favourite air, the poor madman inſtantly ſeemed to brighten up at the ſound; from a recumbent poſture, he began to ſit up; and as the muſician continued playing, the patient ſeemed deſirous of dancing to the ſound: but he was tied, and incapable of leaving his bed, ſo that he could only humour the tune with his head, and that part of his arms which were at liberty. Thus the other continued playing, and the dancing-maſter practiſed his own art, as far as he was able, for about a quarter of an hour, when ſuddenly falling into a deep ſleep, in which his diſorder came to a criſis, he awaked perfectly recovered.

A thouſand other inſtances might be added, equally true: let it ſuffice to add one more, which is not true; we mean that of the tarantula. Every perſon who has been in Italy, now well knows, that the bite of this animal, and its being cured by muſic, is all a deception. When ſtrangers come into that part of the country, the country people are ready enough to take money for dancing to the tarantula. A gentleman had a ſervant who ſuffered himſelf to be bit; the wound, which was little larger than the puncture of a pin, was uneaſy for a few hours, and then became well without any farther aſſiſtance. Some of the country people, however, ſtill make a tolerable livelihood of the credu-

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lity of ſtrangers, as the muſician finds his account in it not leſs than the dancer.

Sounds, like light, are not only extenſively diffuſed, but are frequently reflected. The laws of this reflection, it is true, are not as well underſtood as thoſe of light; all we know is, that ſound is principally reflected by hard bodies; and their being hollow alſo, ſometimes increaſes the reverberation. No art, however, can make an echo; and ſome, who have beſtowed great labour and expence upon ſuch a project, have only erected ſhapeleſs buildings whoſe ſilence was a mortifying lecture upon their preſumption.

The internal cavity of the ear ſeems to be fitted up for the purpoſes of echoing ſound with the greateſt preciſion. This part is faſhioned out in the temporal bone, like a cavern cut into a rock. In this the ſound is repeated and articulated; and, as ſome anatomiſts tell us, (for we have as yet but very little knowledge on this ſubject) is beaten againſt the tympanum, or drum of the ear, which moves four little bones joined thereto; and theſe move and agitate the internal air which lies on the other ſide; and laſtly, this air ſtrikes and affects the auditory nerves, which carry the ſound to the brain.

One of the moſt common diſorders in old age is deafneſs; which probably proceed from the rigidity of the nerves in the labyrinth of the ear. This diſorder alſo, ſometimes proceeds from a ſtoppage of the wax, which art may eaſily remedy. In order to know whether the defect be an internal or an external one, let the deaf perſon put a repeating watch into his mouth; and if he hears it ſtrike, he may be aſſured that his diſorder proceeds from an external cauſe, and is, in ſome meaſure, curable: for there is a paſſage for the ears into the mouth, by what anatomiſts call the euſtachian tube; and, by this paſſage, people often hear ſounds, when they are utterly without hearing through the larger channel: and this alſo is the reaſon that we often ſee perſons who liſten with great attention, hearken with their mouths open, in order to catch all the ſound at every aperture.

It often happens, that perſons hear differently with one ear from the other; and it is generally found that theſe have what is called, by muſicians, a bad ear. Mr. Buffon, who has made many trials upon perſons, of this kind, always found that their defect in judging properly of ſounds, proceeded from the inequality of their ears; and receiving by both, at the ſame, unequal ſenſations, they form an unjuſt idea. In this manner, as thoſe people hear falſe, they alſo, without knowing it, ſing falſe. Thoſe perſons alſo frequently deceive themſelves with regard to the ſide from whence the ſound comes, generally ſuppoſing the noiſe to come on the part of the beſt ear.

Such as are hard of hearing find the ſame advantage in the trumpet made for this purpoſe, that ſhort-ſighted perſons do from glaſſes. Theſe trumpets might be eaſily improved, ſo as to increaſe ſounds, in the ſame manner that the teleſcope does objects: however, they could be uſed to advantage only in a place of ſolitude and ſtillneſs, as the neighbouring ſounds would mix with the more diſtant, and the whole would produce in the ear nothing but tumult and confuſion.

Hearing is a much more neceſſary ſenſe to man than to animals. With theſe it is only a warning againſt danger, or an encouragment to mutual aſſiſtance. In man, it is the ſource of moſt of his pleaſures; and without which, the reſt of his ſenſes would be of little benefit. A man born deaf, muſt neceſſarily be dumb; and his whole ſphere of knowledge muſt be bounded only by ſenſual objects. We have an inſtance of a young man who, being born deaf, was reſtored, at the age of twenty-four, to perfect hearing: the account is given in the Memoirs of the Academy of Sciences, 1703, page 18.

A young man of the town of Chartres, between the age of twenty-three and twenty-four, the ſon of a tradeſman, and deaf and dumb from his birth, began to ſpeak all of a ſudden, to the great aſtoniſhment of the whole town. He gave them to underſtand that, about three or four months before he had heard the ſound of bells for the firſt time, and was greatly ſurpriſed at this new and unknown ſenſation. After ſome time a kind of water iſſued from his left ear, and he then heard perfectly well with both. During theſe three months, he was aſſiduouſly employed in liſtening, without ſaying a word, and accuſtoming himſelf to ſpeak ſoftly, ſo as not to be heard, the words pronounced by others. He laboured hard alſo in perfecting himſelf in the pronunciation, and in the ideas attached to every ſound. At length, having ſuppoſed himſelf qualified to break ſilence, he declared, that he could now ſpeak, although as yet but imperfectly. Soon after, ſome able divines queſtioned him concerning his ideas of his paſt ſtate; and principally with reſpect to God, his ſoul, the morality or turpitude of actions. The young man, however, had not driven his ſolitary ſpeculations into that channel. He had gone to maſs indeed with his parents, had learned to ſign himſelf with the croſs, to kneel down and aſſume all the grimaces of a man that was praying; but he did all this without any manner of knowledge of the intention or the cauſe; he ſaw others do the like, and that was enough for him; he knew nothing even of death, and it never entered into his head; he led a life of pure animal inſtinct, entirely taken up with ſenſible objects, and ſuch as were preſent, he did not ſeem even to make as many reflections upon theſe, as might reaſonably be expected from his improving ſituation: and yet, the young man was not in want of underſtanding, but the underſtanding of a man deprived of all commerce with others, is ſo very confined, that the mind is, in ſome meaſure totally under the controul of its immediate ſenſations.

Notwithſtanding, it is very poſſible to communicate ideas to deaf men, which they previouſly wanted, and even give them very preciſe notions of ſome abſtract ſubjects, by means of ſigns, and of letters. A perſon born deaf, may, by time, and ſufficient pains, be taught to write and read, to ſpeak, and, by the motions of the lips, to underſtand what is ſaid to him: however, it is probable that, as moſt of the motions of ſpeech are made within the mouth by the tongue, the knowledge from the motion of the lips, is but very confined: nevertheleſs, a gentleman thus taught has been converſed with, and in all the commonly occurring queſtions, and the uſual ſalutations, he was ready enough, merely by attending to the motion of the lips alone; but when he was ſpoke to for a ſhort continuance, he was totally at a loſs, although he underſtood the ſubject, when written, extremely well. Perſons taught in this manner, were at firſt conſidered as prodigies; but there have been ſo many inſtances of ſucceſs of late, and ſo many are ſkilful in the art of inſtructing in this way, that, though ſtill a matter of ſome curioſity, it ceaſes to be an object of wonder.

CHAP. IX.

OF SMELLING, FEELING, and TASTING.

A N animal may be ſaid to fill up that ſphere which he can reach by his ſenſes, and is actually large in proportion to the ſphere to which its organ

organ extended. By sight, indeed, objects are diffused into a wide circle, that of hearing though less widely diffused, nevertheless extends its powers the farthest of smelling is more contracted still; and the taste and touch are the most confined of all. Thus man enjoys very distant objects, but with one sense only; more nearly he brings two senses at once to bear upon them; his sense of smelling assists the other two, at its own distance, and of such objects, as a man, he may be said to be in perfect possession.

Each sense, however, the more it acts at a distance, the more capable it is of making combinations; and is, consequently, the more improveable. Refined imaginations, and men of strong minds, take more pleasure, therefore, in improving the delights of the distant senses, than in enjoying such as are scarce capable of improvement.

By combining the objects of the extensive senses, all the arts of poetry, painting, and harmony, have been discovered; but the closer senses, if we may so call them, such as smelling, tasting, and touching, are, in some measure, as simple as they are limited, and admit of little variety. The man of imagination makes a great and an artificial happiness, by the pleasure of altering and combining; the sensualist just stops where he began, and values only those pleasures which he cannot improve. The sensualist is contented with those enjoyments that are already made to his hand; but the man of pleasure is best pleased with growing happiness.

Of all the senses, perhaps, there is not one in which man is more inferior to other animals than in that of smelling. With man, it is a sense that acts in a narrow sphere, and disgusts almost as frequently as it gives him pleasure. With many other animals it is diffused to a very great extent; and never seems to offend them. Dogs not only trace the steps of other animals, but also discover them by the scent, at a very great distance; and, while they are thus exquisitely sensible of all smells, they seem no way disgusted by any.

But, although this sense is, in general, so very inferior in man, it is much stronger in those nations that abstain from animal food, than among Europeans. The Bramins of India have a power of smelling equal to what it is in most other creatures. They can smell the water which they drink, that to us seems quite inodorous, and have a word, in their language, which denotes a country of fine water. We are told, also, that the Negroes of the Antilles, by the smell alone, can distinguish between the footsteps of a Frenchman and a Negro. It is possible, therefore, that we may dull this organ by our luxurious way of living; and sacrifice to the pleasures of taste those which might be received from perfume.

However, it is a sense that we can, in some measure, dispense with; and we have known many that wanted it entirely, with but very little inconvenience from its loss. In a state of nature it is said to be useful in guiding us to proper nourishment, and deterring us from that which is unwholesome; but, in our present situation, such information is but little wanted, and, indeed, but little attended to. In fact, the sense of smelling gives us very often false intelligence. Many things that have a disagreeable odour are, nevertheless, wholesome, and pleasant to the taste; and such as make eating an art, seldom think a meal fit to please the appetite till it begins to offend the nose. On the other hand, there are many things that smell most gratefully, and yet are noxious, or fatal to the constitution. Some physicians think that perfumes, in general, are unwholesome; that they relax the nerves, produce head-aches, and even retard digestion. The mentmel apple, which is known to be deadly poison, is possessed of the most grateful odour. Some of those mineral vapours that are often found fatal, in the stomach, smell like the sweetest flowers, and continue thus to flatter till they destroy. This sense, therefore, as it should seem, was never meant to direct us in the choice of food, but appears rather as an attendant than a necessary pleasure.

Indeed, if we examine the natives of different countries, or even different natives of the same, we shall find no pleasure in which they differ so widely as that of smelling. Some persons are pleased with the smell of a rose, while we have known others that could not abide to have it approach them. The savage nations are highly delighted with the smell of assafœtida, which is to us the most nauseous stink in nature. It would, in a manner, seem that our delight in perfumes was made by habit, and that a very little industry could bring us totally to invert the perception of odours.

Thus much is certain, that many bodies which at one distance are an agreeable perfume, when nearer are a most ungrateful odour. Musk, and ambergrease, in small quantities, are considered by most persons as highly fragrant; and yet, when in larger masses, their scent is insufferable. From a mixture of two bodies, each whereof is, of itself, void of all smell, a very powerful smell may be drawn. Thus, by grinding quick-lime with sal ammoniac, may be produced a very fœtid mixture. On the contrary, from a mixture of two bodies, that are separately disagreeable, a very pleasant aromatic odour may be gained. A mixture of aqua fortis with spirit of wine produces this effect. But not only the alterations of bodies, by each other, but the smallest change in us, makes a very great alteration in this sense, and frequently deprives us of it totally. A slight cold often hinders us from smelling, and as often changes the nature of odours. Some persons, from disorder, retain an incurable aversion to those smells which most pleased them before; and many have been known to have an antipathy to some animals, whose presence they instantly perceive by the smell. From all this, therefore, the sense of smelling appears to be an uncertain monitor, easily disordered, and not much missed when totally wanting.

The sense most nearly allied to smelling is that of tasting. This, some have been willing to consider merely as a nicer kind of touch, and have undertaken to account, in a very mechanical manner, for the difference of savours. Such bodies, say they, as are pointed, happening to be applied to the papillæ of the tongue, excite a very powerful sensation, and give us the idea of saltness. Such, on the contrary, as are of a rounder figure, slide smoothly along the papillæ, and are perceived to be sweet. In this manner they have, with minute labour, gone through the variety of imagined forms in bodies, and have given them as imaginary effects. All we can precisely determine upon the nature of tastes is, that the bodies to be tasted must be either somewhat moistened, or, in some measure, dissolved by the saliva, before they can produce a proper sensation: when both the tongue itself, and the body to be tasted, are extremely dry, no taste whatever ensues. The sensation is then changed, and the tongue, instead of tasting can only be said, like any other part of the body, to feel the object.

It is for this reason, that children have a stronger relish of tastes than those who are more advanced in life. This organ with them, from the greater moisture of their bodies, is kept in greater perfection, and is, consequently, better adapted to perform its functions. Every person remembers how great a pleasure he found in sweets while a child; but his taste growing more obtuse, with age, he is obliged

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to uſe artificial means to excite it. It is then that he is found to call in the aſſiſtance of poignant ſauces, and ſtrong reliſhes, of ſalts and aromatics; all which the delicacy of his tender organ, in childhood, were unable to endure. His taſte grows callous to the natural reliſhes; and is artificially formed to others more unnatural; ſo that the higheſt epicure may be ſaid to have the moſt depraved taſte; as it is owing to the bluntneſs of his organs that he is obliged to have recourſe to ſuch a variety of expedients, to gratify his appetite.

As ſmells are often rendered agreeable by habit, ſo alſo taſtes may be. Tobacco, and coffee, ſo pleaſing to many, are yet, at firſt, very diſagreeable to all. It is not without perſeverance that we begin to have a reliſh for them; we force nature ſo long, that what was conſtraint, in the beginning, at laſt becomes inclination.

The groſſeſt, and yet the moſt uſeful of all the ſenſes, is that of feeling. We are often ſeen to ſurvive under the loſs of the reſt; but of this we can never be totally deprived, but with life. Although this ſenſe is diffuſed over all parts of the body, yet it moſt frequently happens that thoſe parts which are moſt exerciſed in touching, acquire the greateſt degree of accuracy. Thus the fingers, by long habit, become greater maſters in the art than any others, even where the ſenſation is more delicate and fine. It is from this habit, therefore, and their peculiar formation, and not, as is ſuppoſed, from their being furniſhed with a greater quantity of nerves, that the fingers are thus perfectly qualified to judge of forms. Blind men, who are obliged to uſe them much oftner, have this ſenſe much finer; ſo that the delicacy of the touch ariſes rather from the habit of conſtantly employing the fingers, than from any fancied nervouſneſs in their conformation.

All animals that are furniſhed with hands, ſeem to have more underſtanding than others. Monkeys have ſo many actions, like thoſe of men, that they appear to have ſimilar ideas of the form of bodies. All other creatures, deprived of hands, can have no diſtinct ideas of the ſhape of the objects, by which they are ſurrounded, as they want this organ, which ſerves to examine and meaſure their forms, their riſings and depreſſions. A quadrupede probably conceives as erroneous an idea of any thing near him, as a child would of a rock, or a mountain, that it beheld at a diſtance. It may be for this reaſon, that we often ſee them frighted at things with which they ought to be better acquainted. Fiſhes, whoſe bodies are covered with ſcales, and who have no organs for feeling, muſt be the moſt ſtupid of all animals. Serpents, that are likewiſe deſtitute, are yet, by winding round ſeveral bodies, better capable of judging of their form. All theſe, however, can have but very imperfect ideas from feeling; and we have already ſeen, when deprived of this ſenſe, how little the reſt of the ſenſes are to be relied on.

The feeling therefore, is the guardian, the judge, and the examiner of all the reſt of the ſenſes. It eſtabliſhes their information, and detects their errors. All the other ſenſes are altered by time, and contradict their former evidence; but the touch ſtill continues the ſame; and though extremely confined in its operations, yet it is never found to deceive. The univerſe, to a man who had only uſed the reſt of his ſenſes, would be but a ſcene of illuſion; every object miſrepreſented, and all its properties unknown. Mr. Buffon has imagined a man juſt newly brought into exiſtence, deſcribing the illuſion of his firſt ſenſations, and pointing out the ſteps by which he arrived at reality. He conſiders him as juſt created, and awaking amidſt the productions of Nature; and to animate the narrative ſtill more ſtrongly, has made his philoſophical man a ſpeaker. The reader will, no doubt, recollect Adam's ſpeech in Milton, as being ſimilar. One treats the ſubject more as a poet, the other more as a philoſopher. The philoſopher's man deſcribes his firſt ſenſation in the following manner:

"I well remember that joyful anxious moment when I firſt became acquainted with my own exiſtence. I was quite ignorant of what I was, how I was produced, or from whence I came. I opened my eyes: what an addition to my ſurprize! the light of the day, the azure vault of heaven, the verdure of the earth, the chryſtal of the waters, all employed me at once, and animated and filled me with inexpreſſible delight. I at firſt imagined that all thoſe objects were within me, and made a part of myſelf.

"Impreſſed with this idea, I turned my eyes to the ſun; its ſplendor dazzled and overpowered me: I ſhut them once more; and, to my great concern, I ſuppoſed that, during this ſhort interval of darkneſs, I was again returning to nothing.

"Afflicted, ſeized with aſtoniſhment, I pondered a moment on this great change, when I heard a variety of unexpected ſounds. The whiſtling of the wind, and the melody of the grove, formed a concert, the ſoft cadence of which ſunk upon my ſoul. I liſtened for ſome time, and was perſuaded that all this muſic was within me.

"Quite occupied with this new kind of exiſtence, I had already forgotten the light which was my firſt inlet into life, when I once more opened my eyes, and found myſelf again in poſſeſſion of my former happineſs. The gratification of the two ſenſes at once, was a pleaſure too great for utterance.

"I turned my eyes upon a thouſand various objects: I ſoon found that I could loſe them, and reſtore them at will; and amuſed myſelf more at leiſure with a repetition of this new-made power.

"I now began to gaze without emotion, and to hearken with tranquillity, when a light breeze, the freſhneſs of which charmed me, wafted its perfumes to my ſenſe of ſmelling, and gave me ſuch ſatisfaction as even increaſed my ſelf-love.

"Agitated, rouzed by the various pleaſures of my new exiſtence, I inſtantly aroſe, and perceived myſelf moved along, as if by ſome unknown and ſecret power.

"I had ſcarce proceeded forward, when the novelty of my ſituation once more rendered me immoveable. My ſurprize returned; I ſuppoſed that every object around me had been in motion: I gave to them that agitation which I produced by changing place; and the whole creation ſeemed once more in diſorder.

"I lifted my hand to my head; I touched my forehead; I felt my whole frame: I then ſuppoſed that my hand was the principal organ of my exiſtence; all its informations were diſtinct and perfect; and ſo ſuperior to the ſenſes I had yet experienced, that I employed myſelf for ſome time in repeating its enjoyments: every part of my perſon I touched, ſeemed to touch my hand in turn; and gave back ſenſation for ſenſation.

"I ſoon found, that this faculty was expanded over the whole ſurface of my body; and I now firſt began to perceive the limits of my exiſtence, which I had in the beginning ſuppoſed ſpread over all the objects I ſaw.

"Upon caſting my eyes upon my body, and ſurveying my own form, I thought it greater than all the objects that ſurrounded me. I gazed upon my perſon with pleaſure; I examined the formation of my hand, and all its motions; it ſeemed to me large or little in proportion as I approached it to my eyes; I brought it very near, and it then hid almoſt every other object from my ſight. I began ſoon, however,

ever, to find that my sight gave me uncertain information, and resolved to depend upon my feeling for redress.

"This precaution was of the utmost service; I renewed my motions, and walked forward with my face turned towards the heavens. I happened to strike lightly against a palm-tree, and this renewed my surprize: I laid my hand on this strange body; it seemed replete with new wonders, for it did not return me sensation for sensation, as my former feelings had done. I perceived that there was something external, and which did not make a part of my own existence.

"I now, therefore, resolved to touch whatever I saw, and vainly attempted to touch the sun; I stretched forth my arm, and felt only yielding air: at every effort, I fell from one surprize into another, for every object appeared equally near me; and it was not till after an infinity of trials, that I found some objects further removed than the rest.

"Amazed with the illusions, and the uncertainty of my state, I sat down beneath a tree; the most beautiful fruits hung upon it, within my reach; I stretched forth my hand, and they instantly separated from the branch. I was proud of being able to grasp a substance without me; I held them up, and their weight appeared to me like an animated power that endeavoured to draw them to the earth. I found a pleasure in conquering their resistance.

"I held them near my eye; I considered their form and beauty; their fragrance still more allured me to bring them nearer; I approached them to my lips, and drank in their odours; the perfume invited my sense of tasting, and I soon tried a new sense—How new! how exquisite! Hitherto I had tasted only of pleasure; but now it was luxury. The power of tasting gave me the idea of possession.

"Flattered with this new acquisition, I continued its exercise, till an agreeable languor stealing upon my mind, I felt all my limbs become heavy, and all my desires suspended. My sensations were now no longer vivid and distinct; but seemed to lose every object, and presented only feeble images, confusedly marked. At that instant I sunk upon the flowery bank, and slumber seized me. All now seemed once more lost to me. It was then as if I was returning into my former nothing. How long my sleep continued, I cannot tell; as I yet had no perception of time. My awaking appeared like a second birth; I then perceived that I had ceased for a time to exist. This produced a new sensation of fear; and from this interruption in life, I began to conclude that I was not formed to exist for ever.

"In this state of doubt and perplexity, I began to harbour new suspicions; and to fear that sleep had robbed me of some of my late powers: when, turning on one side, to resolve my doubts, what was my amazement, to behold another being, like myself, stretched by my side! New ideas now began to arise; new passions, as yet unperceived, with fears, and pleasures, all took possession of my mind, and prompted my curiosity: love served to complete that happiness which was begun in the individual; and every sense was gratified in all its varieties."

CHAP. X.

Of old AGE and DEATH.

EVERY thing in nature has its improvement and decay. The human form is no sooner arrived at its state of perfection than it begins to decline. The alteration is, at first, insensible; and, often, several years are elapsed before we find ourselves grown old. The news of this disagreeable change, too generally, comes from without, and we learn from others that we grow old, before we are willing to believe the report.

When the body has come to its full height, and is extended into its just dimensions; it then also begins to receive an additional bulk, which rather loads than assists it. This is formed from fat; which generally, at the age of thirty-five, or forty, covers all the muscles, and interrupts their activity. Every action is then performed with greater labour, and the increase of size only serves as a forerunner of decay.

The bones, also, become every day more solid. In the embryo they are as soft almost as the muscles and the flesh; but, by degrees, they harden, and acquire their natural vigour; but still, however, the circulation is carried on through them; and, how hard soever the bones may seem, yet the blood holds its current through them as through all other parts of the body. Of this we may be convinced, by an experiment, which was first accidentally discovered, by our ingenious countryman Mr. Belcher. Perceiving, at a friend's house, that the bones of hogs, which were fed upon madder, were red, he tried it upon various animals, by mixing this root with their usual food; and he found that it tinctured the bones in all: an evident demonstration that the juices of the body had a circulation through the bones. He fed some animals alternately upon madder and their common food, for some time, and he found their bones tinctured with alternate layers, in conformity to their manner of living. From all this, he naturally concluded, that the blood circulated through the bones as it does through every other part of the body; and that, how solid soever they seemed, yet, like the softest parts, they were furnished, through all their substance, with their proper canals. Nevertheless, these canals are of very different capacities, during the different stages of life. In infancy they are capacious; and the blood flows almost as freely through the bones as through any other part of the body; in manhood their size is greatly diminished; the vessels are almost imperceptible; and the circulation through them is proportionably slow. But, in the decline of life, the blood, which flows through the bones, no longer contributing to their growth, must necessarily serve to increase their hardness. The channels, that every where run through the human frame, may be compared to those pipes that we every where see crusted on the inside, by the water, for a long continuance, running through them. Both, every day grow less and less, by the small rigid particles which are deposited within them. Thus as the vessels are by degrees diminished, the juices, also, which were necessary for the circulation through them, are diminished in proportion; till, at length, in old age, those props of the human frame are not only more solid but more brittle.

The cartilages, or gristles, which may be considered as bones beginning to be formed, grow also more rigid. The juices circulating through them, for there is a circulation through all parts of the body, every day contributes to render them harder; so that these substances, which in youth are elastic and pliant, in age become hard and bony. As these cartilages are generally placed near the joints, the motion of the joints also must, of consequence, become more difficult. Thus, in old age, every action of the body is performed with labour; and the cartilages, formerly so supple, will now sooner break than bend.

As the cartilages acquire hardness, and unfit the joints for motion, so also that mucous liquor, which is always separated between the joints, and which serves, like oil to an hinge, to give them an easy

and ready play, is now grown more ſcanty. It becomes thicker, and more clammy, more unfit for anſwering the purpoſes of motion; and from thence, in old age, every joint is not only ſtiff, but awkward. At every motion, this clammy liquor is heard to crack; and it is not without the greateſt effort of the muſcles that its reſiſtance is overcome.

The membranes that cover the bones, the joints, and the reſt of the body, become, as we grow old, more denſe and more dry. Theſe which ſurround the bones, ſoon ceaſe to be ductile. The fibres, of which the muſcles or fleſh is compoſed, become every day more rigid; and, while to the touch the body ſeems, as we advance in years, to grow ſofter, it is, in reality, increaſing in hardneſs. It is the ſkin, and not the fleſh, that we feel upon ſuch occaſions. The fat, and the flabbineſs of that, ſeems to give an appearance of ſoftneſs, which the fleſh itſelf is very far from having. There are few can doubt this after trying the difference between the fleſh of young and old animals. The firſt is ſoft and tender, the laſt is hard and dry.

The ſkin is the only part of the body that age does not contribute to harden. That ſtretches to every degree of tenſion; and we have horrid inſtances of its pliancy, in many diſorders incident to humanity. In youth, therefore, while the body is vigorous and increaſing, it ſtill gives way to its growth. But, although it thus adapts itſelf to our increaſe, it does not in the ſame manner conform to our decay. The ſkin, which in youth was filled, and glofſy, when the body begins to decline, has not elaſticity enough to ſhrink entirely with its diminution. It hangs, therefore, in wrinkles, which no art can remove. The wrinkles of the body, in general, proceed from this cauſe. But thoſe of the face ſeem to proceed from another; namely, from the many varieties of poſitions into which it is put by the ſpeech, the food, or the paſſions. Every grimace, and every paſſion wrinkles up the viſage into different forms. Theſe are viſible enough in young perſons; but what at firſt was accidental, or tranſitory, becomes unalterably fixed in the viſage as it grows older. From hence we may conclude, that a freedom from paſſions not only adds to the happineſs of the mind, but preſerves the beauty of the face; and the perſon that has not felt their influence, is leſs ſtrongly marked by the decays of nature.

Hence, therefore, as we advance in age, the bones, the cartilages, the membranes, the fleſh, the ſkin, and every fibre of the body, becomes more ſolid, more brittle, and more dry. Every part ſhrinks, every motion becomes more ſlow; the circulation of the fluids is performed with leſs freedom; perſpiration diminiſhes; the ſecretions alter; the digeſtion becomes ſlow and laborious; and the juices, no longer ſerving to convey their accuſtomed nouriſhment, thoſe parts may be ſaid to live no longer when the circulation ceaſes. Thus the body dies by little and little: all its functions are diminiſhed by degrees; life is driven from one part of the frame to another; univerſal rigidity prevails; and death at laſt ſeizes upon the little that is left.

As the bones, the cartilages, the muſcles, and all other parts of the body are ſofter in women than in men, theſe parts muſt, of conſequence, require a longer time to come to that hardneſs which haſtens death. Women, therefore, ought to be a longer time in growing old than men; and this is actually the caſe. If we conſult the tables which have been drawn up reſpecting human life, we ſhall find, that after a certain age they are more long lived than men, all other circumſtances the ſame. A woman of ſixty has a better chance than a man of the ſame age to live till eighty. Upon the whole we may infer, that ſuch perſons as have been ſlow in coming up to maturity, will alſo be ſlow in growing old; and this holds as well with regard to other animals as to man.

The whole duration of the life of either vegetables, or animals, may be, in ſome meaſure, determined from their manner of coming to maturity. The tree, or the animal, which takes but a ſhort time to increaſe to its utmoſt pitch, periſhes much ſooner than ſuch as are leſs premature. In both, the increaſe upwards is firſt accompliſhed; and not till they have acquired their greateſt degree of height do they begin to ſpread in bulk. Man grows in ſtature till about the age of ſeventeen; but his body is not completely developed till about thirty. Dogs, on the other hand, are at their utmoſt ſize in a year, and become as bulky as they uſually are in another. However, man who is ſo long in growing, continues to live for fourſcore, or an hundred years; but the dog ſeldom above twelve or thirteen. In general, alſo, it may be ſaid that large animals live longer than little ones, as they uſually take a longer time to grow. But in all animals one thing is equally certain, that they carry the cauſes of their own decay about them; and that their deaths are neceſſary and inevitable. The proſpects which ſome viſionaries have formed of perpetuating life by remedies, have been often enough proved falſe by their own example. Such unaccountable ſchemes would, therefore, have died with them, had not the love of life always augmented our credulity.

When the body is naturally well formed, it is poſſible to lengthen out the period of life for ſome years by management. Temperance in diet is often found conducive to this end. The famous Cornaro, who lived to above an hundred years although his conſtitution was naturally feeble, is a ſtrong inſtance of the benefit of an abſtemious life. Moderation in the paſſions, alſo, many contribute to extend the term of our exiſtence. Fontenelle, the celebrated writer, was naturally of a very weak and delicate habit of body. He was affected by the ſmalleſt irregularities; and had frequently ſuffered ſevere fits of illneſs from the ſlighteſt cauſes. But the remarkable equality of his temper, and his ſeeming want of paſſion, lengthened out his life to above an hundred. It was remarkable of him, that nothing could vex or make him uneaſy; every occurrence ſeemed equally pleaſing; and no event, however unfortunate, ſeemed to come unexpected. However, the term of life can be prolonged but for a very little time by any art we can uſe. We are told of men who have lived beyond the ordinary duration of human exiſtence; ſuch as Par, who lived to an hundred and forty-four; and Jenkins to an hundred and ſixty-five; yet theſe men uſed no peculiar arts to prolong life; on the contrary, it appears that theſe, as well as ſome others, remarkable for their longevity, were peaſants, accuſtomed to the greateſt fatigues, who had no ſettled rules of diet, but who often indulged in accidental exceſſes. Indeed, if we conſider that the European, the Negroe, the Chineſe, and the American, the civilized man, and the ſavage, the rich and the poor, the inhabitants of the city, and of the country, though all ſo different in other reſpects, are yet entirely ſimilar in the period allotted them for living; if we conſider that neither the difference of race, of climate, of nouriſhment, of convenience, or of ſoil, makes any difference in the term of life; if we conſider that thoſe men who live upon raw fleſh, or dried fiſhes, upon ſeago, or rice, upon caſſava, or upon roots, nevertheleſs live as long as thoſe who are fed upon bread and meat, we ſhall readily be brought to acknowledge, that the duration of life depends neither upon habit, cuſtoms, or the quantity of food; we ſhall confeſs, that nothing can change the laws of that mechaniſm which regulates the number of our years, and which can chiefly be affected only by long faſting, or great exceſs.

If

If there be any difference in the different periods of man's exiſtence, it ought principally to be aſcribed to the quality of the air. It has been obſerved, that in elevated ſituations there have been found more old people than in thoſe that were low. The mountains of Scotland, Waſes, Auvergne, and Switzerland, have furniſhed more inſtances of extreme old age than the plains of Holland, Flanders, Germany, or Poland. But, in general, the duration of life is nearly the ſame in moſt countries. Man, if not cut off by accidental diſeaſes, is often found to live to ninety or an hundred years. Our anceſtors did not live beyond that date; and, ſince the time of David, this term has undergone little alteration.

If we be aſked how in the beginning men lived ſo much longer than at preſent, and by what means their lives were extended to nine hundred and thirty, or even nine hundred and ſixty years, it may be anſwered, that the productions of the earth, upon which they fed, might be of a different nature at that time, from what they are at preſent. It may be anſwered, that the term was abridged by Divine command, in order to keep the earth from being over-ſtocked with human inhabitants; ſince, if every perſon were now to live and generate for nine hundred years, mankind would be increaſed to ſuch a degree, that there would be no room for ſubſiſtence: ſo that the plan of Providence would be altered; which is ſeen not to produce life, without providing a proper ſupply.

But, to whatever extent life may be prolonged, or however ſome may have delayed the effects of age, death is the certain goal to which all are haſtening. All the cauſes of decay which have been mentioned, contribute to bring on this dreaded diſſolution. However, nature approaches to this awful period, by ſlow and imperceptible degrees; life is conſuming day after day; and ſome one of our faculties, or vital principles, is every hour dying before the reſt; ſo that death is only the laſt ſhade in the picture: and it is probable, that man ſuffers a greater change in going from youth to age, than from age into the grave. When we firſt begin to live, our lives may ſcarcely be ſaid to be our own; as the child grows, life increaſes in the ſame proportion: and is at its height in the prime of manhood. But as ſoon as the body begins to decreaſe, life decreaſes alſo; for, as the human frame diminiſhes, and its juices circulate in ſmaller quantity, life diminiſhes and circulates with leſs vigour; ſo that as we begin to live by degrees, we begin to die in the ſame manner.

Why then ſhould we fear death, if our lives have been ſuch as not to make eternity dreadful! Why ſhould we fear that moment which is prepared by a thouſand other moments of the ſame kind! the firſt pangs of ſickneſs being probably greater than the laſt ſtruggles of departure. Death, in moſt perſons, is as calmly endured as the diſorder that brings it on. If we enquire from thoſe whoſe buſineſs it is to attend the ſick and the dying, we ſhall find that, except in a very few acute caſes, where the patient dies in agonies, the greateſt number die quietly, and ſeemingly without pain; and even the agonies of the former, rather terrify the ſpectators, than torment the patient; for how many have we not ſeen who have been accidentally relieved from this extremity, and yet had no memory of what they then endured? In fact, they had ceaſed to live, during that time when they ceaſed to have ſenſation; and their pains were only thoſe of which they had an idea.

The greateſt number of mankind die, therefore, without ſenſation; and of thoſe few that ſtill preſerve their faculties entire to the laſt moment, there is ſcarce one of them that does not alſo preſerve the hopes of ſtill out-living his diſorder. Nature, for the happineſs of man, has rendered this ſentiment ſtronger than his reaſon. A perſon dying of an incurable diſorder, which he muſt know to be ſo, by frequent examples of his caſe; which he perceives to be ſo, by the inquietude of all around him, by the tears of his friends, and the departure or the face of the phyſician, is, nevertheleſs, ſtill in hopes of getting over it. His intereſt is ſo great that he only attends to his own repreſentations; the judgment of others is conſidered as an haſty concluſion; and while death every moment makes new inroads upon his conſtitution, and deſtroys life in ſome part, hope ſtill ſeems to eſcape the univerſal ruin, and is the laſt that ſubmits to the blow.

Caſt your eyes upon a ſick man, who has an hundred times told you that he felt himſelf dying, that he was convinced he could not recover, and that he was ready to expire; examine what paſſes on his viſage, when, through zeal or indiſcretion, any one comes to tell him that his end is at hand. You will ſee him change, like one who is told an unexpected piece of news. He now appears not to have thoroughly believed what he had been telling you himſelf; he doubted much; and his fears were greater than his hopes: but he ſtill had ſome feeble expectations of living, and would not have ſeen the approaches of death, unleſs he had been alarmed by the miſtaken aſſiduity of his attendants.

Death, therefore, is not that terrible thing which we ſuppoſe it to be. It is a ſpectre which frights us at a diſtance, but which diſappears when we come to approach it more cloſely. Our ideas of its terrors are conceived in prejudice, and dreſſed up by fancy; we regard it not only as the greateſt misfortune, but alſo as an evil accompanied with the moſt excruciating tortures: we have even increaſed our apprehenſions, by reaſoning on the extent of our ſufferings. It muſt be dreadful, ſay ſome, ſince it is ſufficient to ſeparate the ſoul from the body; it muſt be long, ſince our ſufferings are proportioned to the ſucceſſion of our ideas; and theſe being painful, muſt ſucceed each other with extreme rapidity. In this manner has falſe philoſophy laboured to augment the miſeries of our nature; and to aggravate that period, which Nature has kindly covered with inſenſibility. Neither the mind, nor the body, can ſuffer theſe calamities; the mind is, at that time, moſtly without ideas; and the body too much enfeebled to be capable of perceiving its pain. A very acute pain produces either death, or fainting, which is a ſtate ſimilar to death: the body can ſuffer but to a certain degree; if the torture becomes exceſſive, it deſtroys itſelf; and the mind ceaſes to perceive, when the body can no longer endure.

In this manner, exceſſive pain admits of no reflection; and wherever there are any ſigns of it, we may be ſure that the ſufferings of the patient are no greater than what we ourſelves may have remembered to endure.

But, in the article of death, we have many inſtances in which the dying perſon has ſhewn that very reflection which pre-ſuppoſes an abſence of the greateſt pain; and, conſequently, that pang which ends life, cannot even be ſo great as thoſe which have preceded. Thus, when Charles XII. was ſhot at the ſiege of Frederickſhall, he was ſeen to clap his hand on the hilt of his ſword; and although the blow was great enough to terminate one of the boldeſt and braveſt lives in the world, yet it was not painful enough to deſtroy reflection. He perceived himſelf attacked; he reflected that he ought to defend himſelf, and his body obeyed the impulſe of his mind, even in the laſt extremity. Thus it is the prejudice of perſons in health, and not the body in pain, that makes us ſuffer from the approach of death; we have, all our lives, contracted an habit of making out exceſſive pleaſures

and

and pains; and nothing but repeated experience shews us, how seldom the one can be suffered, or the other enjoyed to the utmost.

If there be any thing necessary to confirm what we have said, concerning the gradual cessation of life, or the insensible approaches of our end, nothing can more effectually prove it, than the uncertainty of the signs of death. If we consult what Winslow or Bruhier have said upon this subject, we shall be convinced, that between life and death, the shade is so very undistinguishable, that even all the powers of art can scarcely determine where the one ends, and the other begins. The colour of the visage, the warmth of the body, the suppleness of the joints, are but uncertain signs of life still subsisting; while on the contrary, the paleness of the complexion, the coldness of the body, the stiffness of the extremities, the cessation of all motion, and the total insensibility of the parts, are but uncertain marks of death begun. In the same manner also, with regard to the pulse, and the breathing, these motions are often so kept under, that it is impossible to perceive them. By approaching a looking-glass to the mouth of the person supposed to be dead, people often expect to find whether he breathes or not. But this is a very uncertain experiment: the glass is frequently sullied by the vapour of the dead man's body; and often the person is still alive, although the glass is no way tarnished. In the same manner, neither burning, nor scarifying, neither noises in the ears, nor pungent spirits applied to the nostrils, give certain signs of the discontinuance of life; and there are many instances of persons who have endured them all, and afterwards recovered, without any external assistance, to the astonishment of the spectators. How careful, therefore, should we be, before we commit those who are dearest to us to the grave, to be well assured of their departure? Experience, justice, humanity, all persuade us not to hasten the funerals of our friends, but to keep their bodies unburied, until we have certain signs of their real decease.

CHAP. XI.

Of the Varieties in the HUMAN Race.

WE have hitherto considered man as an individual, endowed with excellencies above the rest of the creation; we now come to consider the advantages which men have over men, and the various kinds with which our earth is inhabited.

If we compare the minute differences of mankind, there is scarce one nation upon the earth that entirely resembles another; and there may be said to be as many different kinds of men as there are countries inhabited. One polished nation does not differ more from another, than the merest savages do from those savages that lie even contiguous to them; and it frequently happens that a river, or a mountain, divides two barbarous tribes that are unlike each other in manners, customs, features, and complexion. But these differences, however perceivable, do not form such distinctions as come within a general picture of the varieties of mankind. Custom, accident, or fashion, may produce considerable alterations in neighbouring nations; their being derived from ancestors of a different climate, of complexion, may contribute to make accidental distinctions, which every day grow less; and it may be said, that two neighbouring nations, how unlike soever at first, will assimilate by degrees; and, by long continuance, the difference between them will at last become almost imperceptible. It is not, therefore, between contiguous nations we are to look for any strong marked varieties in the human species; it is by comparing the inhabitants of opposite climates, and distant countries; those who live within the polar circle with those beneath the equator; those that live on one side of the globe with those that occupy the other.

Of all animals, the differences between mankind are the smallest. Of the lower races of creatures, the changes are so great as often entirely to disguise the natural animal, and to distort or to disfigure its shape. But the chief differences in man are rather taken from the tincture of his skin than the variety of his figure; and in all climates he preserves his erect deportment, and the marked superiority of his form. If we look round the world there seem to be not above six distinct varieties in the human species, each of which is strongly marked, and speaks the kind seldom to have mixed with any other. But there is nothing in the shape, nothing in the faculties, that shews their coming from different originals; and the varieties of climate, of nourishment, and custom, are sufficient to produce every change.

The first distinct race of men is found round the polar regions. The Laplanders, the Esquimaux Indians, the Samœid Tartars, the inhabitants of Nova Zembla, the Borandians, the Greenlanders, and the natives of Kamtschatka, may be considered as one peculiar race of people, all greatly resembling each other in their stature, their complexion, their customs, and their ignorance. These nations being under a rigorous climate, where the productions of nature are but few, and the provisions coarse and unwholesome, their bodies have shrunk to the nature of their food; and their complexions have suffered, from cold, almost a similar change to what heat is known to produce; their colour being a deep brown, in some places inclining to actual blackness. These, therefore, in general, are found to be a race of short stature, and odd shape, with countenances as savage as their manners are barbarous. The visage, in these countries, is large and broad, the nose flat and short, the eyes of a yellowish brown inclining to blackness, the eye-lids drawn towards the temples, the cheek-bones extremely high, the mouth very large, the lips thick and turned outwards, the voice thin and squeaking, the head large, the hair black and streight, the colour of the skin of a dark greyish. They are short in stature, the generality not being above four feet high, and the tallest not above five. Among all these nations the women are as deformed as the men, and resemble them so nearly that one cannot, at first, distinguish the sexes among them.

These nations not only resemble each other in their deformity, their dwarfishness, the colour of their hair and eyes, but they have, in a great measure, the same inclinations, and the same manners, being all equally rude, superstitious, and stupid. The Danish Laplanders have a large black cat, to which they communicate their secrets, and consult in all their affairs. Among the Swedish Laplanders there is in every family a drum for consulting the devil; and, although these nations are robust, and nimble, yet they are so cowardly, that they never can be brought into the field. Gustavus Adolphus attempted to form a regiment of Laplanders, but he found it impossible to accomplish his design; for it should seem that they can live only in their own country, and in their own manner. They make use of skates, which are made of fir, of near three feet long, and half a foot broad; these are pointed, and raised before, and tied to the foot by straps of leather. With these they skate upon the icy snow with such velocity, that they very easily overtake the swiftest animals. They make use also of a pole, pointed with iron at one end, and rounded at the other. This pole serves to push them along, to di-

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A GREENLANDER

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rect their courſe, to ſupport them from falling, to ſtop the impetuoſity of their motion, and to kill that game which they have overtaken. Upon theſe ſkates they deſcend the ſteepeſt mountains, and ſcale the moſt craggy precipices; and, in theſe exerciſes, the women are not leſs ſkilful than the men. They have all the uſe of the bow and arrow, which ſeems to be a contrivance common to all barbarous nations; and which, however, at firſt, required no ſmall ſkill to invent. They launch a javelin alſo, with great force; and ſome ſay that they can hit a mark, no larger than a crown, at thirty yards diſtance, and with ſuch force as would pierce a man through. They are all hunters; and particularly purſue the ermine, the fox, the ounce, and the martin, for the ſake of their ſkins. Theſe they barter, with their ſouthern neighbours, for brandy and tobacco; both which they are fond of to exceſs. Their food is principally dried fiſh, the fleſh of rein-deer and bears. Their bread is compoſed of the bones of fiſhes, pounded and mixed with the inſide bark of the pine-tree. Their drink is train-oil, or brandy, and, when deprived of theſe, water, in which juniper berries have been infuſed. With regard to their morals, they have all the virtues of ſimplicity, and all the vices of ignorance. They offer their wives and daughters to ſtrangers; and ſeem to think it a particular honour if their offer be accepted. They have no idea of religion, or a Supreme Being; the greateſt number of them are idolaters; and their ſuperſtition is as profound as their worſhip is contemptible. Wretched and ignorant as they are, yet they do not want pride; they ſet themſelves far above the reſt of mankind; and Krantz aſſures us, that when the Greenlanders are got together, nothing is ſo cuſtomary among them as to turn the Europeans into ridicule. They are obliged, indeed, to yield them the pre-eminence in underſtanding, and mechanic arts; but they do not know how to ſet any value upon theſe. They therefore count themſelves the only civilized and well-bred people in the world; and it is common with them, when they ſee a quiet, or a modeſt ſtranger, to ſay that he is almoſt as well bred as a Greenlander.

From this deſcription, therefore, this whole race of people may be conſidered as diſtinct from any other. Their long continuance in a climate the moſt inhoſpitable, their being obliged to ſubſiſt on food the moſt coarſe and ill prepared, the ſavageneſs of their manners, and their laborious lives, all have contributed to ſhorten their ſtature, and to deform their bodies. In proportion as we approach towards the north pole, the ſize of the natives appears to diminiſh, growing leſs and leſs as we advance higher, till we come to thoſe latitudes that are deſtitute of all inhabitants whatſoever.

The wretched natives of theſe climates ſeem fitted by nature to endure the rigours of their ſituation. As their food is but ſcanty and precarious, their patience in hunger is amazing. A man, who has ate nothing for four days, can manage his little canoe, in the moſt furious waves, and calmly ſubſiſt in the midſt of a tempeſt, that would quickly daſh an European boat to pieces. Their ſtrength is not leſs amazing than their patience; a woman among them will carry a piece of timber, or a ſtone, near double the weight of what an European can lift. Their bodies are of a dark grey all over; and their faces brown, or olive. The tincture of their ſkins partly ſeems to ariſe from their dirty manner of living, being generally daubed with train-oil; and partly from the rigours of climate, as the ſudden alterations of cold and raw air in winter, and of burning heats in ſummer, ſhade their complexions by degrees, till, in a ſucceſſion of generations, they at laſt become almoſt black. As the countries in which theſe reſide are the moſt barren, ſo the natives ſeem the moſt barbarous of any part of the earth. Their more ſouthern neighbours of America, treat them with the ſame ſcorn that a poliſhed nation would treat a ſavage one; and we may readily judge of the rudeneſs of thoſe manners, which even a native of Canada can think more barbarous than his own.

But the gradations of nature are imperceptible; and, while the north is peopled with ſuch miſerable inhabitants, there are here and there to be found, upon the edges of theſe regions, people of larger ſtature, and completer figure. A whole race of the dwarfiſh breed is often found to come down from the north, and ſettle more to the ſouthward; and, on the contrary, it ſometimes happens that ſouthern nations are ſeen higher up, in the midſt of theſe diminutive tribes, where they have continued for time immemorial. Thus the Oſtiac Tartars ſeem to be a race that have travelled down from the north, and to be originally ſprung from the minute ſavages we have been deſcribing. There are alſo Norwegians, and Finlanders, of proper ſtature, who are ſeen to inhabit in latitudes higher even than Lapland. Theſe, however, are but accidental migrations, and ſerve as ſhades to unite the diſtinct varieties of mankind.

The ſecond great variety, in the human ſpecies, ſeems to be that of the Tartar race; from whence, probably, the little men we have been deſcribing originally proceeded. The Tartar country, taken in general, comprehends the greateſt part of Aſia; and is, conſequently, a general name given to a number of nations, of various forms and complexions. But, however they ſeem to differ from each other, they all agree in being very unlike the people of any other country. All theſe nations have the upper part of the viſage very broad, and wrinkled even while yet in their youth. Their noſes are ſhort and flat, their eyes little and ſunk in their heads; and, in ſome of them, they are ſeen five or ſix inches aſunder. Their cheek-bones are high, the lower part of their viſage narrow, the chin long and advanced forward, their teeth of an enormous ſize and growing ſeparate from each other, their eye-brows thick, large, and covering their eyes, their eye-lids thick, the face broad and flat, the complexion olive coloured, and the hair black. They are of a middle ſize, extremely ſtrong, and very robuſt. They have but little beard, which grows ſtragglingly on the chin. They have large thighs, and ſhort legs. The uglieſt of all are the Calmoucks, in whoſe appearance there ſeems to be ſomething frightful. They all lead an erratic life, remaining under tents of hair, or ſkins. They live upon horſe-fleſh and that of camels, either raw or a little ſodden between the horſe and the ſaddle. They eat alſo fiſh dried in the ſun. Their moſt uſual drink is mares milk fermented with millet ground into meal. They all have the head ſhaven, except a lock of hair, on the top, which they let grow ſufficiently long to form into treſſes, on each ſide of the face. The women, who are as ugly as the men, wear their hair, which they bind up with bits of copper and other ornaments of a like nature. The majority of theſe nations have no religion, no ſettled notions of morality, no decency of behaviour. They are chiefly robbers: and the natives of Dageſtan, who live near their more poliſhed neighbours, make a traffic of Tartar ſlaves who have been ſtolen, and ſell them to the Turks and the Perſians. Their chief riches conſiſt in horſes, of which perhaps there are more in Tartary, than in any other part of the world. The natives are taught by cuſtom to live in the ſame place with their horſes; they are continually employed in managing them, and

and at laſt bring them to ſuch great obedience, that the horſe ſeems actually to underſtand the rider's intention.

To this race of men alſo, we muſt refer the Chineſe and the Japaneſe, however different they ſeem in their manners and ceremonies. It is the form of the body we are now principally conſidering; and there is, between theſe countries, a ſurpriſing reſemblance. It is in general allowed that the Chineſe have broad faces, ſmall eyes, flat noſes, and ſcarce any beard; that they are broad and ſquare-ſhouldered, and rather leſs in ſtature than Europeans. Theſe are marks common to them and the Tartars, and they may, therefore, be conſidered as being derived from the ſame original. "I have obſerved," ſays Chardin, "that in all the people from the eaſt and the north of the Caſpian ſea, to the peninſula of Malacca, that the lines of the face, and the formation of the viſage, is the ſame. This has induced me to believe, that all theſe nations are derived from the ſame original, however different either their complexions or their manners may appear: for as to the complexion, that proceeds entirely from the climate and the food; and as to the manners, theſe are generally the reſult of their different degrees of wealth or power." That they come from one ſtock, is evident alſo, from this; that the Tartars who ſettle in China, quickly reſemble the Chineſe; and, on the contrary, the Chineſe who ſettle in Tartary, ſoon aſſume the figure, and the manners of the Tartars.

The Japaneſe ſo much reſemble the Chineſe, that one cannot heſitate to rank them in the ſame claſs. They only differ in being rather browner, as they inhabit a more ſouthern climate. They are, in general, deſcribed, as of a brown complexion, a ſhort ſtature, a broad flat face, a very little beard, and black hair. Their cuſtoms and ceremonies are nearly the ſame; their ideas of beauty ſimilar; and their artificial deformities of blackening the teeth, and bandaging the feet, entirely alike in both countries. They both, therefore, proceed from the ſame ſtock; and although they differ very much from their brutal progenitors, yet they owe their civilization wholly to the mildneſs of the climate in which they reſide, and to the peculiar fertility of the ſoil. To this tribe alſo, we may refer the Cochin-Chineſe, the Siameſe, the Tonquineſe, and the inhabitants of Aracan, Laos, and Pegu, who, though all differing from the Chineſe, and each other, nevertheleſs, have too ſtrong a reſemblance, not to betray their common original.

Another, which makes the third variety in the human ſpecies, is that of the ſouthern Aſiatics; the form of whoſe features and perſons may be eaſily diſtinguiſhed from thoſe of the Tartar races. The nations that inhabit the peninſula of India, ſeem to be the principal ſtock from whence the inhabitants of the iſlands that lie ſcattered in the Indian ocean, have been peopled. They are, in general, of a ſlender ſhape, with long ſtrait black hair, and often with Roman noſes. Thus they reſemble the Europeans in ſtature and features; but greatly differ in colour and habit of body. The Indians are of an olive colour, and, in the more ſouthern parts, quite black; although the word Mogul, in their language, ſignifies a white man. The women are extremely delicate, and bathe very often: they are of an olive colour, as well as the men; their legs and thighs are long, and their bodies ſhort, which is the oppoſite to what is ſeen among the women of Europe. They are, it is ſaid, by no means ſo fruitful as the European women; but they feel the pains of child-birth with much leſs ſenſibility, and are generally up and well the day following. In fact, theſe pains ſeem greateſt in all countries where the women are moſt delicate, or the conſtitution enfeebled by luxury or indolence. The women of ſavage nations ſeem in a great meaſure exempt from painful labours; and even the hard-working wives of the peaſants among ourſelves, have this advantage, from a life of induſtry, that their child-bearing is leſs painful. Over all India, the children arrive ſooner at maturity, than with us of Europe. They often marry, and conſummate, the huſband at ten years old, and the wife at eight; and they frequently have children at that age. However, the women who are mothers ſo ſoon, ceaſe bearing before they are arrived at thirty; and, at that time, they appear wrinkled, and ſeem marked with all the deformities of age. The Indians have long been remarkable for their cowardice and effeminacy; every conqueror that has attempted the invaſion of their country, having ſucceeded. The warmth of the climate entirely influences their manners; they are ſlothful, ſubmiſſive and luxurious: ſatisfied with ſenſual happineſs alone, they find no pleaſure in thinking; and contented with ſlavery, they are ready to obey any maſter. Many tribes among them eat nothing that has life; they are fearful of killing the meaneſt inſect; and have even erected hoſpitals for the maintainance of all kinds of vermin. The Aſiatic dreſs is a looſe flowing garment, rather fitted for the purpoſes of peace and indolence, than of induſtry or war. The vigour of the Aſiatics is in general conformable to their dreſs and nouriſhment; fed upon rice, and cloathed in effeminate ſilk veſtments, their ſoldiers are unable to oppoſe the onſet of an European army; and, from the times of Alexander to the preſent day, we have ſcarce any inſtances of their ſucceſs in arms. Upon the whole, therefore, they may be conſidered as a feeble race of ſenſualiſts, too dull to find rapture in any pleaſures, and too indolent to turn their gravity into wiſdom. To this claſs we may refer the Perſians and Arabians, and, in general, the inhabitants of the iſlands that lie ſcattered in the Indian ocean.

The fourth ſtriking variety in the human ſpecies, is to be found among the Negroes of Africa. This gloomy race of mankind is found to blacken all the ſouthern parts of Africa, from eighteen degrees north of the line, to its extreme termination, at the Cape of Good Hope. It is ſaid, that the Caffres, who inhabit the ſouthern extremity of that large continent, are not to be ranked among the Negroe race; however, the difference between them, in point of colour and features, is ſo ſmall, that they may very eaſily be grouped in this general picture. Each of the Negroe nations, it muſt be owned, differ from each other; they have their peculiar countries for beauty, like us; and different nations, as in Europe, pride themſelves upon the regularity of their features. Thoſe of Guinea, for inſtance, are extremely ugly, and have an inſupportable ſcent; thoſe of Moſambique are reckoned beautiful, and have no ill ſmell whatſoever. The Negroes, in general, are of a black colour, with a ſmooth ſoft ſkin. This ſmoothneſs proceeds from the downy ſoftneſs of the hair which grows upon it; the ſtrength of which gives a roughneſs to the feel, in thoſe of a white complexion. Their ſkins, therefore, have a velvet ſmoothneſs, and ſeem leſs braced upon the muſcles than ours. The hair of their heads differs entirely from what we are accuſtomed to, being ſoft, woolly, and ſhort. The beard alſo, partakes of the ſame qualities; but in this it differs, that it ſoon turns grey, which the hair is ſeldom found to do; ſo that ſeveral are ſeen with white beards, and black hair, at the ſame time. Their eyes are generally of a deep hazle; their noſes flat and ſhort, their lips thick and tumid, and their teeth of an ivory whiteneſs. This their only beauty, however, is ſet off by the colour of their ſkin; the contraſt between the

NATURAL HISTORY of MAN.

A MALABAR

A TARTAR

An ALGERINE

A JAVANESE

A HIGHLANDER

An HUNGARIAN

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black and white being the more obſervable. It is falſe to ſay that their features are deformed by art; ſince, in the Negroe children born in European countries, the ſame deformities are ſeen to prevail; the ſame flatneſs in the noſe; and the ſame prominence in the lips. They are, in general, ſaid to be well ſhaped; but there is ſeldom found one that might be juſtly called ſo; their legs being moſtly ill formed, and commonly bending outward on the ſhin-bone. But it is not only in thoſe parts of their bodies that are obvious, that they are diſproportioned; thoſe parts which among us are uſually concealed by dreſs, with them are large and languid. The women's breaſts, after bearing one child, hang down below the navel; and it is cuſtomary, with them, to ſuckle the child at their backs, by throwing the breaſt over the ſhoulder. As their perſons are thus naturally deformed, at leaſt to our imaginations, their minds are equally incapable of ſtrong exertions. The climate ſeems to relax their mental powers ſtill more than thoſe of the body; they are, therefore, in general, found to be ſtupid, indolent, and miſchievous. The Arabians themſelves, many colonies of whom have migrated ſouthward into the moſt inland parts of Africa, ſeem to have degenerated from their anceſtors; forgetting their ancient learning, and loſing their beauty, they have become a race ſcarce any way diſtinguiſhable from the original natives. Nor does it ſeem to have fared otherwiſe with the Portugueſe, who, about two centuries ago, ſettled along this coaſt. They alſo are become almoſt as black as the Negroes; and are ſaid, by ſome, to be even more barbarous.

The inhabitants of America make a fifth race, as different from all the reſt in colour, as they are diſtinct in habitation. The natives of America (except in the northern extremity, where they reſemble the Laplanders) are of a red or copper colour; and although, in the old world, different climates produce a variety of complexions and cuſtoms, the natives of the new continent ſeem to reſemble each other in almoſt every reſpect. They are all nearly of one colour; all have black thick ſtrait hair, and thin black beards; which, however, they take care to pluck out by the roots. They have, in general, flat noſes, with high cheek bones, and ſmall eyes; and theſe deformities of nature they endeavour to increaſe by art; they flatten the noſe, and often the whole head of their children, while the bones are yet ſuſceptible of every impreſſion. They paint the body and face of various colours, and conſider the hair upon any part of it, except the head, as a deformity which they are careful to eradicate. Their limbs are generally ſlighter made than thoſe of the Europeans; and they are far from being ſo ſtrong. All theſe ſavages ſeem to be cowardly; they ſeldom are known to face their enemies in the field, but fall upon them at an advantage; and the greatneſs of their fears ſerves to increaſe the rigours of their cruelty. The wants which they often ſuſtain, makes them ſurpriſingly patient in adverſity; diſtreſs, by being grown familiar, becomes leſs terrible; ſo that their patience is leſs the reſult of fortitude than of cuſtom. They have all a ſerious air, although they ſeldom think; and, however cruel to their enemies, are kind and juſt to each other. In ſhort, the cuſtoms of ſavage nations in every country are almoſt the ſame; a wild, independent, and precarious life, produces a peculiar train of virtues and vices: and patience and hoſpitality, indolence and rapacity, content and ſincerity, are found not leſs among the natives of America, than all the barbarous nations of the globe.

The ſixth and laſt variety of the human ſpecies, is that of the Europeans, and the nations bordering on them. In this claſs we may reckon the Georgians, Circaſſians, and Mingrelians, the inhabitants of Aſia Minor, and the northern parts of Africa, together with a part of thoſe countries which lie north-weſt of the Caſpian ſea. The inhabitants of theſe countries differ a good deal from each other; but they generally agree in the colour of their bodies, the beauty of their complexions, the largeneſs of their limbs, and the vigour of their underſtandings. Thoſe arts which might have had their invention among the other races of mankind, have come to perfection there. In barbarous countries, the inhabitants go either naked, or are awkwardly cloathed in furs or feathers; in countries ſemi-barbarous, the robes are looſe and flowing; but here the cloathing is leſs made for ſhew than expedition, and unites, as much as poſſible, the extremes of ornament and diſpatch.

To one or other of theſe claſſes, we may refer the people of every country; and as each nation has been leſs viſited by ſtrangers, or has had leſs commerce with the reſt of mankind, we find their perſons, and their manners, more ſtrongly impreſſed with one or other of the characters mentioned above. On the contrary, in thoſe places where trade has long flouriſhed, or where enemies have made many incurſions, the races are uſually found blended, and properly fall beneath no one character. Thus, in the iſlands of the Indian ocean, where a trade has been carried on for time immemorial, the inhabitants appear to be a mixture of all the nations upon the earth; white, olive, brown, and black men, are all ſeen living together in the ſame city, and propagate a mixed breed, that can be referred to none of the claſſes into which naturaliſts have thought proper to divide mankind.

Of all the colours by which mankind is diverſified, it is eaſy to perceive, that ours is not only the moſt beautiful to the eye, but the moſt advantageous. The fair complexion ſeems, if we may ſo expreſs it, as a tranſparent covering to the ſoul; all the variations of the paſſions, every expreſſion of joy or ſorrow, flows to the cheek, and, without language, marks the mind. In the ſlighteſt change of health alſo, the colour of the European face is the moſt exact index, and often teaches us to prevent thoſe diſorders that we do not as yet perceive; not but that the African black, and the Aſiatic olive complexions, admit of their alterations alſo; but theſe are neither ſo diſtinct, nor ſo viſible, as with us; and, in ſome countries, the colour of the viſage is never found to change; but the face continues in the ſame ſettled ſhade in ſhame, and in ſickneſs, in anger, and deſpair.

The colour, therefore, moſt natural to man, ought to be that which is moſt becoming; and it is found, that, in all regions, the children are born fair, or at leaſt red; and that they grow more black or tawny, as they advance in age. It ſhould ſeem, conſequently, that man is naturally white; ſince the ſame cauſes that darken the complexion in infants, may have originally operated, in ſlower degrees, in blackening whole nations. We could, therefore, readily account for the blackneſs of different nations, did we not ſee the Americans, who live under the line, as well as the natives of Negroeland, of a red colour, and but a very ſmall ſhade darker than the natives of the northern latitudes, in the ſame continent. For this reaſon, ſome have ſought for other cauſes of blackneſs than the climate; and have endeavoured to prove that the blacks are a race of people, bred from one man, who was marked with accidental blackneſs. This, however, is but mere ungrounded conjecture; and, although the Americans are not ſo dark as the Negroes, yet we muſt ſtill continue in the ancient opinion, that the deepneſs of the colour proceeds from the exceſſive heat of the climate; for if we compare the heats of Africa with thoſe of America, we ſhall find they bear no

proportion

proportion to each other. In America, all that part of the continent which lies under the line, is cool and pleaſant, either ſhaded by mountains, or refreſhed by breezes from the ſea; but, in Africa, the wide tract of country that lies under the line is very extenſive, and the ſoil ſandy: the reflection of the ſun, therefore, from ſo large a ſurface of the earth, is almoſt intolerable; and it is not to be wondered at, that the inhabitants ſhould bear, in their looks, the marks of the inhoſpitable climate. In America, the country is but thinly inhabited; and the more torrid tracts are generally left deſert by the inhabitants; for which reaſon they are not ſo deeply tinged by the beams of the ſun. But in Africa the whole face of the country is fully peopled; and the natives are obliged to endure their ſituation, without a power of migration. It is there, conſequently, that they are in a manner tied down to feel all the ſeverity of the heat; and their complexions take the darkeſt hue they are capable of receiving. We need not, therefore, have recourſe to any imaginary propagation, from perſons accidentally black, ſince the climate is a cauſe obvious, and ſufficient to produce the effect.

In fact, if we examine the complexion of different countries, we ſhall find them darken in proportion to the heat of their climate; and the ſhades gradually to deepen as they approach the line. Some nations, indeed, may be found not ſo much tinged by the ſun as others, although they lie nearer the line. But this ever proceeds from ſome accidental cauſes; either from the country lying higher, and conſequently being colder; or from the natives bathing oftener, and leading a more civilized life. In general, it may be aſſerted, that as we approach the line, we find the inhabitants of each country grow browner until the colour deepens into perfect blackneſs. Thus taking our ſtandard from the whiteſt race of people, and beginning with our own country, which certainly bids faireſt for the pre-eminence, we ſhall find the French, who are more ſouthern, a ſlight ſhade deeper than we; going farther down, the Spaniards are browner than the French; the inhabitants of Fez darker than they; and the natives of Negroeland the darkeſt of all. In what manner the ſun produces this effect, and how the ſame luminary which whitens wax and linen, ſhould darken the human complexion, is not eaſy to conceive. Sir Thomas Brown firſt ſuppoſed that a mucous ſubſtance, which had ſomething of a vitriolic quality, ſettled under the reticular membrane, and grew darker with heat. Others have ſuppoſed that the blackneſs lay in the epidermis, or ſcarf ſkin, which was burnt up like leather. But nothing has been ſatisfactorily diſcovered upon the ſubject; it is ſufficient that we are aſſured of the fact; and that we have no doubt of the ſun's tinging the complexion in proportion to its vicinity.

But we are not to ſuppoſe that the ſun is the only cauſe of darkening the ſkin; the wind, extreme cold, hard labour, or coarſe and ſparing nouriſhment, are all found to contribute to this effect. We find the peaſants of every country, who are moſt expoſed to the weather, a ſhade darker than the higher ranks of people. The ſavage inhabitants of all places are expoſed ſtill more, and, therefore, contract a ſtill deeper hue; and this will account for the tawny colour of the North American Indians. Although they live in a climate the ſame, or even more northerly than ours, yet they are found to be of complexions very different from thoſe of Europe. But it muſt be conſidered that they live continually expoſed to the ſun; that they uſe many methods to darken their ſkins by art, painting them with red ochre, and anointing them with the fat of bears. Had they taken, for a ſucceſſion of ſeveral generations, the ſame precautions to brighten their colour that an European does, it is very probable that they would in time come to have ſimilar complexions; and, perhaps, diſpute the prize of beauty.

The extremity of cold is not leſs productive of a tawny complexion than that of heat. The natives of the arctic circle, as was obſerved, are all brown; and thoſe that lie moſt to the north are almoſt entirely black. In this manner both extremes are unfavourable to the human form and colour, and the ſame effects are produced under the poles that are found at the line.

With regard to the ſtature of different countries, that ſeems chiefly to reſult from the nature of the food, and the quantity of the ſupply. Not but that the ſeverity of heat or cold, may, in ſome meaſure, diminiſh the growth, and produce a dwarfiſhneſs of make. But, in general, the food is the great agent in producing this effect; where that is ſupplied in large quantities, and, where its quality is wholeſome and nutrimental, the inhabitants are generally ſeen above the ordinary ſtature. On the contrary, where it is afforded in a ſparing quantity, or very coarſe, and void of nouriſhment in its kind, the inhabitants degenerate, and ſink below the ordinary ſize of mankind. In this reſpect they reſemble other animals, whoſe bodies, by proper feeding, may be greatly augmented. An ox, on the fertile plains of India, grows to a ſize four times as large as the diminutive animal of the ſame kind bred in the Alps. The horſes bred in the plains are larger than thoſe of the mountain. So it is with man; the inhabitants of the valley are uſually found taller than thoſe of the hill: the natives of the Highlands of Scotland, for inſtance, are ſhort, broad, and hardy; thoſe of the Lowlands are tall and ſhapely. The inhabitants of Greenland, who live upon dried fiſh and ſeals, are leſs than thoſe of Gambia or Senegal, where Nature ſupplies them with vegetable and animal abundance.

The form of the face ſeems rather to be the reſult of cuſtom. Nations who have long conſidered ſome artificial deformity as beautiful, who have induſtriouſly leſſened the feet, or flattened the noſe, by degrees, begin to receive the impreſſion they are taught to aſſume; and Nature, in a courſe of ages, ſhapes itſelf to the conſtraint, and aſſumes hereditary deformity. We find nothing more common in births than for children to inherit ſometimes even the accidental deformities of their parents. We have many inſtances of ſquinting in the father, which he received from fright, or habit, communicated to the offſpring; and we have ſeen a child diſtinctly marked with a ſcar, ſimilar to one the father had received in battle. In this manner accidental deformities may become natural ones; and by aſſiduity may be continued, and even increaſed, through ſucceſſive generations. From this, therefore, may have ariſen the ſmall eyes and long ears of the Tartars, and Chineſe nations. From hence originally may have come the flat noſes of the blacks, and the flat heads of the American Indians.

In this ſlight ſurvey, therefore, we may ſee that all the variations in the human figure, as far as they differ from our own, are produced either by the rigour of the climate, the bad quality, or the ſcantineſs of the proviſions, or by the ſavage cuſtoms of the country. They are actual marks of the degeneracy in the human form; and we may conſider the European figure and colour as ſtandards to which to refer all other varieties, and with which to compare them. In proportion as the Tartar or American approaches nearer to European beauty, we conſider the race as leſs degenerated; in proportion as he differs more widely, he has made greater deviation from his original form.

That we have all ſprung from one common parent, we are taught, both by reaſon and religion, to believe;

lieve, and we have good reason alſo to think that the Europeans reſemble him more than any of the reſt of his children. However, it muſt not be concealed that the olive coloured Aſiatic, and even the jet black Negroe, claim this honour of hereditary reſemblance; and aſſert that white men are mere deviations from original perfection. Odd as this opinion may ſeem, they have Linnæus, the celebrated naturaliſt, on their ſide, who ſuppoſes man a native of the tropical climates, and only a ſojourner more to the north. But, not to enter into a controverſy upon a matter of a very remote ſpeculation, one argument alone will ſuffice to prove the contrary, and ſhew that the white man is the original ſource from whence the other varieties have ſprung. We have frequently ſeen white children produced from black parents, but have never ſeen a black offspring the production of two whites. From hence we may conclude that whiteneſs is the colour to which mankind naturally tends; for, as in the tulip, the parent ſtock is known by all the artificial varieties breaking into it; ſo in man, that colour muſt be original which never alters, and to which all the reſt are accidentally ſeen to change. We have ſeen in London, at different times, two white Negroes, the iſſue of black parents, that ſerved to convince us of the truth of this theory. We had before been taught to believe that the whiteneſs of the Negroe ſkin was a diſeaſe, a kind of milky whiteneſs, that might be called rather a leprous cruſt than a natural complexion. We were taught to ſuppoſe that the numberleſs white Negroes, found in various parts of Africa, the white men that go by the name of Chacrelas, in the Eaſt-Indies, and the white Americans, near the Iſthmus of Darien, in the Weſt Indies, were all as ſo many diſeaſed perſons, and even more deformed than the blackeſt of the natives. But, upon examining that Negroe which was laſt ſhewn in London, the colour was found to be exactly like that of an European; the viſage white and ruddy, and the lips of the proper redneſs. However, there were ſufficient marks to convince us of its deſcent. The hair was white and woolly, and very unlike any thing ever ſeen before. The iris of the eye was yellow, inclining to red; the noſe was flat, exactly reſembling that of a Negro; and the lips thick, and prominent. No doubt, therefore, remained of the child's having been born of Negroe parents; and the perſon who ſhewed it had atteſtations to convince the moſt incredulous. From this then we ſee that the variations of the Negroe colour is into whiteneſs, whereas the white are never found to have a race of Negroe children. Upon the whole, all thoſe changes which the African, the Aſiatic, or the American undergo, are but accidental deformities, which a kinder climate, better nouriſhment, or more civilized manners, would, in a courſe of centuries, very probably remove.

CHAP. XII.

Of MONSTERS.

HITHERTO we have only ſpoken of thoſe varieties in the human ſpecies, that are common to whole nations; but there are varieties of another kind, which are only found in the individual; and, being more rarely ſeen, are, therefore, called monſtrous. If we examine into the varieties of diſtorted nature, there is ſcarce a limb of the body, or a feature in the face, that has not ſuffered ſome reprobation, either from art or nature; being enlarged or diminiſhed, lengthened or wreſted, from its due proportion. Linnæus, after having given a catalogue of monſters, particularly adds, the flat heads of Canada, the long heads of the Chineſe, and the ſlender waiſts of the women of Europe, who, by ſtrait lacing, take ſuch pains to deſtroy their health, through a miſtaken deſire to improve their beauty. It belongs more to the phyſician than the naturaliſt to attend to theſe minute deformities; and, indeed, it is a melancholy contemplation to ſpeculate upon a catalogue of calamities, inflicted by unpitying nature, or brought upon us by our own caprice. Some, however, are fond of ſuch accounts; and there have been books filled with nothing elſe. It is ſufficient here to obſerve, that every day's experience muſt have ſhewn us miſerable inſtances of this kind, produced by nature, or affectation; calamities that no pity can ſoften, nor aſſiduity relieve.

Paſſing over, therefore, every other account, we ſhall only mention the famous inſtance, quoted by Father Malbranche; upon which he founds his beautiful theory of monſtrous productions. A woman of Paris, the wife of a tradeſman, went to ſee a criminal broke alive upon the wheel, at the place of public execution. She was at that time two months advanced in her pregnancy, and no way ſubject to any diſorders to affect the child in her womb. She was, however, of a tender habit of body; and, though led by curioſity to this horrid ſpectacle, very eaſily moved to pity and compaſſion. She felt, therefore, all thoſe ſtrong emotions which ſo terrible a ſight muſt naturally inſpire; ſhuddered at every blow the criminal received, and almoſt ſwooned at his cries. Upon returning from this ſcene of blood, ſhe continued for ſome days penſive, and her imagination ſtill wrought upon the ſpectacle ſhe had lately ſeen. After ſome time, however, ſhe ſeemed perfectly recovered from her fright, and had almoſt forgotten her former uneaſineſs. When the time of her delivery approached, ſhe ſeemed no ways mindful of her former terrors, nor were her pains in labour more than uſual in ſuch circumſtances. But, what was the amazement of her friends, and aſſiſtants, when the child came into the world! It was found that every limb in its body was broken like thoſe of the malefactor, and juſt in the ſame place. This poor infant, that had ſuffered the pains of life, even before its coming into the world, did not die, but lived in an hoſpital, in Paris, for twenty years after, a wretched inſtance of the ſuppoſed powers of imagination in the mother, of altering and diſtorting the infant in the womb. The manner in which Malbranche reaſons upon this fact, is as follows: The Creator has eſtabliſhed ſuch a ſympathy between the ſeveral parts of nature, that we are led not only to imitate each other, but alſo to partake in the ſame affections and deſires. The animal ſpirits are thus carried to the reſpective parts of the body, to perform the ſame actions which we ſee others perform, to receive in ſome meaſure their wounds, and take part in their ſufferings. Experience tells us, that if we look attentively on any perſon ſeverely beaten, or ſorely wounded, the ſpirits immediately flow into thoſe parts of the body which correſpond to thoſe we ſee in pain. The more delicate the conſtitution, the more it is thus affected; the ſpirits making a ſtronger impreſſion on the fibres of a weakly habit than of a robuſt one. Strong vigorous men ſee an execution without much concern, while women of nicer texture are ſtruck with horror and concern. This ſenſibility in them muſt, of conſequence, be communicated to all parts of their body; and, as the fibres of the child, in the womb, are incomparably finer than thoſe of the mother, the courſe of the animal ſpirits muſt, conſequently, produce greater alterations. Hence, every ſtroke given to the criminal, forcibly ſtruck the imagination of the

woman; and by a kind of counter ſtroke, the delicate tender frame of the child.

Such is the reaſoning of an ingenious man, upon a fact the veracity of which many ſince have called in queſtion. They have allowed, indeed, that ſuch a child might have been produced, but have denied the cauſe of its deformity. How could the imagination of the mother, ſay they, produce ſuch dreadful effects upon her child? She has no communication with the infant; ſhe ſcarce touches it in any part; quite unaffected with her concerns, it ſleeps in ſecurity, in a manner ſecluded by a fluid in which it ſwims, from her that bears it. With what a variety of deformities, ſay they, would all mankind be marked, if all the vain and capricious deſires of the mother were thus readily written upon the body of child? Yet, notwithſtanding this plauſible way of reaſoning, we cannot avoid giving ſome credit to the variety of inſtances we have either read, or ſeen, upon this ſubject. If it be a prejudice, it is as old as the days of Ariſtotle, and to this day as ſtrongly believed, by the generality of mankind, as ever. It does not admit of a reaſon; and, indeed, we can give none even why the child ſhould, in any reſpect, reſemble the father, or the mother. The fact we generally find to be ſo. But why it ſhould take the particular print of the father's features in the womb, is as hard to conceive, as why it ſhould be affected by the mother's imagination. We all know what a ſtrong effect the imagination has on thoſe parts in particular, without being able to aſſign a cauſe how this effect is produced; and why may not the imagination produce the ſame effect in marking the child that it does in forming it? Thoſe perſons whoſe employment it is to rear up pigeons of different colours, can breed them, as their expreſſion is, to a feather. In fact, by properly paring them, they can give what colour they will to any feather, in any part of the body. Were we to reaſon upon this fact, what could we ſay? Might it not be aſſerted, that the egg, being diſtinct from the body of the female, cannot be influenced by it? Might it not be plauſibly ſaid, that there is no ſimilitude between any part of the egg and any particular feather, which we expect to propagate? and yet, for all this, the fact is known to be true, and what no ſpeculation can invalidate. In the ſame manner, a thouſand various inſtances aſſure us that the child, in the womb, is ſometimes marked by the ſtrong affections of the mother; how this is performed we know not; we only ſee the effect, without any connexion between it and the cauſe. The beſt phyſicians have allowed it; and have been ſatisfied to ſubmit to the experience of a number of ages; but many diſbelieve it, becauſe they expect a reaſon for every effect. This, however, is very hard to be given, while it is very eaſy to appear wiſe by pretending incredulity.

Among the number of monſters, dwarfs and giants are uſually reckoned; though not, perhaps, with the ſtricteſt propriety, ſince they are no way different from the reſt of mankind, except in ſtature. It is a diſpute, however, about words; and, therefore, ſcarce worth contending about. But there is a diſpute of a more curious nature, on this ſubject; namely, whether there are races of people thus very diminutive, or vaſtly large, or whether they be merely accidental varieties, that now and then are ſeen in the country, in a few perſons, whoſe bodies ſome external cauſe has contributed to leſſen or enlarge.

With regard to men of diminutive ſtature, all antiquity has been unanimous in aſſerting their national exiſtence. Homer was the firſt who has given us an account of the pigmy nation, contending with the cranes; and what poetical licence might be ſuppoſed to exaggerate, Atheneus has attempted ſeriouſly to confirm by hiſtorical aſſertion. If we attend to theſe, we muſt believe that in the internal parts of Africa, there are whole nations of pigmy beings, not more than a foot in ſtature, who continually wage an unequal war with the birds and beaſts that inhabit the plains in which they reſide. Some of the ancients, however, and Strabo in particular, have ſuppoſed all theſe accounts to be fabulous; and have been more inclined to think this ſuppoſed nation of pigmies, nothing more than a ſpecies of apes, well known to be numerous in that part of the world. With this opinion the moderns have all concurred; and that diminutive race, which was deſcribed as human, has been long degraded into a claſs of animals that reſemble us but very imperfectly.

The exiſtence, therefore, of a pigmy race of mankind, being founded in error, or in fable, we can expect to find men of diminutive ſtature only by accident, among men of the ordinary ſize. Of theſe accidental dwarfs, every country, and almoſt every village, can produce numerous inſtances. There was a time, when theſe unfavoured children of Nature were the peculiar favourites of the great; and no prince, or nobleman, thought himſelf completely attended, unleſs he had a dwarf among the number of his domeſtics. Theſe poor little men were kept to be laughed at; or to raiſe the barbarous pleaſure of their maſters, by their contraſted inferiority. Even in England, as late as the times of king James the Firſt, the court was at one time furniſhed with a dwarf, a giant, and a jeſter: theſe the king often took a pleaſure in oppoſing to each other, and often fomented quarrels among them, in order to be a concealed ſpectator of their animoſity. It was a particular entertainment of the courtiers at that time, to ſee little Jeffery, for ſo the dwarf was called, ride round the liſts, expecting his antagoniſt; and diſcovering, in his actions, all the marks of contemptible reſolution.

It was in the ſame ſpirit, that Peter of Ruſſia, in the year 1710, celebrated a marriage of dwarfs. This monarch, though raiſed by his native genius far above a barbarian, was, nevertheleſs, ſtill many degrees removed from actual refinement. His pleaſures, therefore, were of the vulgar kind; and this was among the number. Upon a certain day, which he had ordered to be proclaimed ſeveral months before, he invited the whole body of his courtiers, and all the foreign ambaſſadors, to be preſent at the marriage of a pigmy man and woman. The preparations for this wedding were not only very grand, but executed in a ſtyle of barbarous ridicule. He ordered, that all the dwarf men and women, within two hundred miles, ſhould repair to the capital; and alſo inſiſted, that they ſhould be preſent at the ceremony. For this purpoſe, he ſupplied them with proper vehicles; but ſo contrived it, that one horſe was ſeen carrying in a dozen of them into the city at once, while the mob followed ſhouting, and laughing, from behind. Some of them were at firſt unwilling to obey an order, which they knew was calculated to turn them into ridicule, and did not come; but he ſoon obliged them to obey; and, as a puniſhment, enjoined, that they ſhould wait upon the reſt at dinner. The whole company of dwarfs amounted to ſeventy, beſide the bride and bridegroom, who were richly adorned, and in the extremity of the faſhion. For this little company in miniature, every thing was ſuitably provided; a low table, ſmall plates, little glaſſes, and, in ſhort, every thing was ſo fitted, as if all things had been dwindled to their own ſtandard. It was his great pleaſure to ſee their gravity and their pride; the contention of the women for places, and the men for ſuperiority. This point he attempted to adjuſt, by ordering, that the moſt diminutive

nutive ſhould take the lead; but this bred diſputes, for none would then conſent to ſit foremoſt. All this, however, being at laſt ſettled, dancing followed the dinner, and the ball was opened with a minuet by the bridegroom, who meaſured exactly three feet two inches high. In the end, matters were ſo contrived, that this little company, who met together in gloomy pride, and unwilling to be pleaſed, being at laſt familiarized to laughter, joined in the diverſion, and became, as the journaliſt has it, extremely ſprightly and entertaining.

But whatever may be the entertainment ſuch gueſts might afford, when united, a dwarf is ſeldom found capable of affording any when alone. They, in general, ſeem to have faculties very much reſembling thoſe of children, and their deſires of the ſame kind; being diverted with the ſame ſports, and beſt pleaſed with ſuch companions. The little man, whoſe name was Coan, that died lately at Chelſea, was the moſt intelligent and ſprightly we ever heard of. But this mirth, and ſeeming ſagacity, were but aſſumed. He had, by long habit, been taught to look chearful upon the approach of company; and his converſation was but the mere etiquette of a perſon that had been uſed to receive viſitors. When driven out of his walk, nothing could be more ſtupid or ignorant, nothing more dejected or forlorn. But, we have a compleat hiſtory of a dwarf, very accurately related by Mr. Daubenton, in his part of the Hiſtoire Naturelle; which we will here take leave to tranſlate.

This dwarf, whoſe name was Baby, was well known, having ſpent the greateſt part of his life at Lunenville, in the palace of Staniſlaus, the titular king of Poland. He was born in the village of Plaiſne, in France, in the year 1741. His father and mother were peaſants, both of good conſtitutions, and inured to a life of huſbandry and labour. Baby, when born, weighed but a pound and a quarter. We are not informed of the dimenſions of his body at that time; but we may conjecture they were very ſmall, as he was preſented on a plate to be baptized, and for a long time lay in a ſlipper. His mouth, although proportioned to the reſt of his body, was not, at that time, large enough to take in the nipple; and he was, therefore, obliged to be ſuckled by a ſhe-goat that was in the houſe; and that ſerved as a nurſe, attending to his cries with a kind of maternal fondneſs. He began to articulate ſome words when eighteen months old; and at two years he was able to walk alone. He was then fitted with ſhoes that were about an inch and a half long. He was attacked with ſeveral acute diſorders; but the ſmall-pox was the only one which left any marks behind it. Until he was ſix years old, he eat no other food but pulſe, potatoes, and bacon. His father and mother were, from their poverty, incapable of affording him any better nouriſhment; and his education was little better than his food, being bred up among the ruſtics of the place. At ſix years old he was about fifteen inches high; and his whole body weighed but thirteen pounds. Notwithſtanding this, he was well proportioned, and handſome; his health was good, but his underſtanding ſcarce paſſed the bounds of inſtinct. It was at that time that the king of Poland, having heard of ſuch a curioſity, had him conveyed to Lunenville, gave him the name of Baby, and kept him in his palace.

Baby, having thus quitted the hard condition of a peaſant, to enjoy all the comforts and the conveniencies of life, ſeemed to receive no alteration from his new way of living, either in mind or perſon. He preſerved the goodneſs of his conſtitution till about the age of ſixteen, but his body ſeemed to increaſe very ſlowly during the whole time; and his ſtupidity was ſuch, that all inſtructions were loſt in improving his underſtanding. He could never be brought to have any ſenſe of religion, nor even to ſhew the leaſt ſigns of a reaſoning faculty. They attempted to teach him dancing and muſic, but in vain; he never could make any thing of muſic; and as for dancing, although he beat time tolerably exact, yet he could never remember the figure, but while his dancing-maſter ſtood by to direct his motions. Notwithſtanding, a mind thus deſtitute of underſtanding was not without its paſſions; anger and jealouſy harraſſed it at times; nor was he without deſires of another nature.

At the age of ſixteen, Baby was twenty-nine inches tall; at this he reſted; but having thus arrived at his acme, the alterations of puberty, or rather, perhaps, of old age, came faſt upon him. From being very beautiful, the poor little creature now became quite deformed; his ſtrength quite forſook him; his back bone began to bend; his head hung forward; his legs grew weak; one of his ſhoulders turned awry; and his noſe grew diſproportionably large. With his ſtrength, his natural ſpirits alſo forſook him; and, by the time he was twenty, he was grown feeble, decrepid, and marked with the ſtrongeſt impreſſion of old age. It had been before remarked by ſome, that he would die of old age before he arrived at thirty; and, in fact, by the time he was twenty-two, he could ſcarcely walk an hundred paces, being worn with the multiplicity of his years, and bent under the burthen of protracted life. In this year he died; a cold, attended with a ſlight fever, threw him into a kind of lethargy, which had a few momentary intervals; but he could ſcarce be brought to ſpeak. However, it is aſſerted, that in the five laſt days of his life, he ſhewed a clearer underſtanding, than in his times of beſt health; but at length he died, after enduring great agonies, in the twenty-ſecond year of his age.

Oppoſite to this accidental diminution of the human race, is that of its extraordinary magnitude. Concerning the reality of a nation of Giants, there have been many diſputes among the learned. Some have affirmed the probability of ſuch a race; and others, as warmly have denied the poſſibility of their exiſtence. But it is not from any ſpeculative reaſonings, upon a ſubject of this kind, that information is to be obtained; it is not from the diſputes of the ſcholar, but the labours of the enterpriſing, that we are to be inſtructed in this enquiry. Indeed, nothing can be more abſurd, than what ſome learned men have advanced upon this ſubject. It is very unlikely, ſays Grew, that there ſhould either be dwarfs or giants; or if ſuch, they cannot be fitted for the uſual enjoyment of life and reaſon. Had man been born a dwarf, he could not have been a reaſonable creature; for to that end, he muſt have a jolt head, and then he would not have body and blood enough to ſupply his brain with ſpirits; or if he had a ſmall head, proportionable to his body, there would not be brain enough for conducting life. But it is ſtill worſe with giants; and there could never have been a nation of ſuch, for there would not be food enough found in any country to ſuſtain them; or if there were beaſts ſufficient for this purpoſe, there would not be graſs enough for their maintainance. But what is ſtill more, add others, giants could never be able to ſupport the weight of their own bodies; ſince a man of ten feet high, muſt be eight times as heavy as one of the ordinary ſtature; whereas, he has but twice the ſize of muſcles to ſupport ſuch a burthen: and, conſequently, would be overloaded with the weight of his own body. Such are the theories upon this ſubject; and they require no other anſwer, but that experience proves them both to be falſe: dwarfs are found capable of life and reaſon; and giants are ſeen to carry their own bodies. We have ſeveral accounts from mariners, that a nation of giants actually exiſts; and mere

ſpeculation

ſpeculation ſhould never induce us to doubt their veracity.

Ferdinand Magellan was the firſt who diſcovered this race of people along the coaſt, towards the extremity of South America. Magellan was a Portugueſe of noble extraction, who having long behaved with great bravery under Albuquerque, the conqueror of India, he was treated with neglect by the court, upon his return. Applying, therefore, to the king of Spain, he was entruſted with the command of five ſhips, to ſubdue the Molucca iſlands, upon one of which he was ſlain. It was in his voyage thither, that he happened to winter in St. Julian's Bay, an American harbour, forty-nine degrees ſouth of the line. In this deſolate region, where nothing was ſeen but objects of terror, where neither trees nor verdure dreſt the face of the country, they remained for ſome months without ſeeing any human creature. They had judged the country to be utterly uninhabitable; when one day, they ſaw approaching, as if he had been dropt from the clouds, a man of enormous ſtature, dancing and ſinging, and putting duſt upon his head, as they ſuppoſed, in token of peace. This overture for friendſhip was, by Magellan's command, quickly anſwered by the reſt of his men; and the giant approaching, teſtified every mark of aſtoniſhment and ſurprize. He was ſo tall, that the Spaniards only reached his waiſt; his face was broad, his colour brown, and painted over with a variety of tints; each cheek had the reſemblance of an heart drawn upon it; his hair was approaching to whiteneſs; he was cloathed in ſkins and armed with a bow. Being treated with kindneſs, and diſmiſſed with ſome trifling preſents, he ſoon returned, with many more of the ſame ſtature; two of whom the mariners decoyed on ſhipboard: nothing could be more gentle than they were in the beginning; they conſidered the fetters that were preparing for them, as ornaments, and played with them, like children with their toys; but when they found for what purpoſe they were intended, they inſtantly exerted their amazing ſtrength, and broke them in pieces with a very eaſy effort. This account, with a variety of other circumſtances, has been confirmed by ſucceeding travellers. Herrera, Sebald Wert, Oliver Van Noort, and James le Maire, all correſpond in affirming the fact, although they differ in many particulars of their reſpective deſcriptions. The laſt voyager we have had, that has ſeen this enormous race, is Byron. We can no longer, therefore, refuſe our aſſent to the exiſtence of this gigantic race of mankind, in what manner they are propagated, or under what regulations they live, is a ſubject that remains for future inveſtigation. It ſhould appear, however, that they are a wandering nation, changing their abode with the courſe of the ſun, and ſhifting their ſituation, for the convenience of food, climate, or paſture.

This race of giants are deſcribed as poſſeſſed of great ſtrength; and, no doubt, they muſt be very different from thoſe accidental giants that are to be ſeen in different parts of Europe. Stature with theſe, ſeems rather their infirmity than their pride; and adds to their burthen, without increaſing their ſtrength. The generality of theſe were ill-formed and unhealthful; weak in their perſons, or incapable of exerting what ſtrength they were poſſeſſed of. The ſame defects of underſtanding that attended thoſe of ſuppreſſed ſtature, were found in thoſe who were thus overgrown: they were heavy, phlegmatic, ſtupid, and inclining to ſadneſs. The numbers, however, are but few; and it is thus kindly ordered by Providence, that as the middle ſtate is the beſt fitted for happineſs, ſo the middle ranks of mankind are produced in the greateſt variety.

However, mankind ſeems naturally to have a reſpect for men of extraordinary ſtature; and it has been a ſuppoſition of long ſtanding, that our anceſtors were much taller, as well as much more beautiful than we. This has been, indeed, a theme of poetical declamation from the beginning; and man was ſcarce formed, when he began to deplore an imaginary decay. Nothing is more natural than this progreſs of the mind, in looking up to antiquity with reverential wonder. Having been accuſtomed to compare the wiſdom of our fathers, with our own in early imbecility, the impreſſion of their ſuperiority remains when they no longer exiſt, and when we ceaſe to be inferior. Thus the men of every age conſider the paſt as wiſer than the preſent; and the reverence ſeems to accumulate as our imaginations aſcend. For this reaſon, we allow remote antiquity many advantages, without diſputing their title: the inhabitants of uncivilized countries repreſent them as taller and ſtronger; and the people of a more poliſhed nation, as more healthy and more wiſe. Nevertheleſs, theſe attributes ſeem to be only the prejudices of ingenuous minds; a kind of gratitude, which we hope in turn to receive from poſterity. The ordinary ſtature of men, Mr. Derham obſerves, is, in all probability, the ſame now as at the beginning. The oldeſt meaſure we have of the human figure, is in the monument of Cheops, in the firſt pyramid of Egypt. This muſt have ſubſiſted many hundred years before the times of Homer, who is the firſt that deplores the decay. This monument, however, ſcarce exceeds the meaſure of our ordinary coffins: the cavity is no more than ſix feet long, two feet wide, and deep in about the ſame proportion. Several mummies alſo, of a very early age, are found to be only of the ordinary ſtature, and ſhew that, for theſe three thouſand years at leaſt, men have not ſuffered the leaſt diminution. We have many corroborating proofs of this, in the ancient pieces of armour which are dug up, in different parts of Europe. The braſs helmet dug up at Medauro, fits one of our men, and yet is allowed to have been left there at the overthrow of Aſdrubal. Some of our fineſt antique ſtatues, which we learn from Pliny and others, to be exactly as big as the life, ſtill continue to this day, remaining monuments of the ſuperior excellence of their workmen indeed, but not of the ſuperiority of their ſtature. We may conclude, therefore, that men have been, in all ages, pretty much of the ſame ſize they are at preſent; and that the only difference muſt have been accidental, or perhaps national.

As to the ſuperior beauty of our anceſtors, it is not eaſy to make the compariſon; beauty ſeems a very uncertain charm; and frequently is leſs in the object, than in the eye of the beholder. Were a modern lady's face formed exactly like the Venus of Medicis, or the ſleeping veſtal, ſhe would ſcarce be conſidered beautiful, except by the lovers of antiquity, whom, of all her admirers, perhaps, ſhe would be leaſt deſirous of pleaſing. It is true, that we have ſome diſorders among us, that diſfigure the features, and from which the ancients were exempt; but it is equally true, that we want ſome which were common among them, and which were equally deforming. As for their intellectual powers, theſe alſo were probably the ſame as ours. We excel them in the ſciences, which may be conſidered as an hiſtory of accumulated experience; and they excel us in the poetic arts, as they had the firſt riſing of all the ſtriking images of Nature.

CHAP.

CHAP. XIII.

Containing a particular Account of MUMMIES, WAX-WORKS, &c.

MAN is not content with the uſual term of life, but he is willing to lengthen out his exiſtence by art; and although he cannot prevent death, he tries to obviate his diſſolution. It is natural to attempt to preſerve even the moſt trifling relicks of what has long given us pleaſure; nor does the mind ſeparate from the body, without a wiſh, that even the wretched heap of duſt it leaves behind, may yet be remembered. The embalming, practiſed in various nations, probably had its riſe in this fond deſire: an urn filled with aſhes, among the Romans, ſerved as a pledge of continuing affection; and even the graſſy graves in our own churchyards, are raiſed above the ſurface, with the deſire that the body below ſhould not be wholly forgotten. The ſoul, ardent after eternity for itſelf, is willing to procure, even for the body, a prolonged duration.

But of all nations, the Egyptians carried this art to the higheſt perfection: as it was a principle of their religion, to ſuppoſe the ſoul continued only coeval to the duration of the body, they tried every art to extend the life of the one, by preventing the diſſolution of the other. In this practice they were exerciſed from the earlieſt ages; and the mummies they have embalmed in this manner, continue in great numbers to the preſent day. We are told, in Geneſis, that Joſeph ſeeing his father expire, gave orders to his phyſicians to embalm the body, which they executed in the compaſs of forty days, the uſual time of embalming. Herodotus alſo, the moſt ancient of the profane hiſtorians, gives us a copious detail of this art, as it was practiſed, in his time, among the Egyptians. "There are certain men among them, ſays he, who practice embalming as a trade; which they perform with all expedition poſſible. In the firſt place, they draw out the brain through the noſtrils, with irons adapted to this purpoſe; and in proportion as they evacuate it in this manner, they fill up the cavity with aromatics; they next cut open the belly, near the ſides, with a ſharpened ſtone, and take out the entrails, which they cleanſe, and waſh in palm oil: having performed this operation, they roll them in aromatic powder, fill them with myrrh, caſſia, and other perfumes, except incenſe: and replace them, ſewing up the body again. After theſe precautions, they ſalt the body with nitre, and keep it in the ſalting-place for ſeventy days, it not being permitted to preſerve it ſo any longer. When the ſeventy days are accompliſhed, and the body waſhed once more, they ſwathe it in bands made of linen, which have been dipt in a gum the Egyptians uſe inſtead of ſalt. When the friends have taken back the body, they make an hollow trough, ſomething like the ſhape of a man, in which they place the body; and this they incloſe in a box, preſerving the whole as a moſt precious relick, placed againſt the wall." Such are the ceremonies uſed with regard to the rich; as for thoſe who are contented with an humbler preparation, they treat them as follows: they fill a ſyringe with an odoriferous liquor extracted from the cedar tree, and, without making an inciſion, inject it up the body of the deceaſed, and then keep it in nitre, as long as in the former caſe. When the time is expired, they evacuate the body of the cedar liquor which had been injected; and ſuch is the effect of this operation, that the liquor diſſolves the inteſtines, and brings them away: the nitre alſo ſerves to eat away the fleſh; and leaves only the ſkin and the bones remaining. This done, the body is returned to the friends, and the embalmer takes no farther trouble about it. The third method of embalming thoſe of the meaneſt condition, is merely by purging and cleanſing the inteſtines by frequent injections, and preſerving the body for a ſimilar term in nitre, at the end of which it is reſtored to the relations.

Diodorus Siculus alſo, makes mention of the manner in which theſe embalmings are performed. According to him, there were ſeveral officers appointed for this purpoſe: the firſt of them, who was called the ſcribe, marked thoſe parts of the body, on the left ſide, which were to be opened; the cutter made the inciſion; and one of thoſe that were to ſalt it, drew out all the bowels, except the heart and the kidnies; another waſhed them in palm-wine, and odoriferous liquors; afterwards they anointed for above thirty days, with cedar, gum, myrrh, cinnamon, and other perfumes. Theſe aromatics preſerved the body entire for a long time, and gave it a very agreeable odour. It was not in the leaſt diſfigured by this preparation; after which it was returned to the relations, who kept it in a coffin, placed upright againſt the wall.

Moſt of the modern writers who have treated on this ſubject, have merely repeated what has been ſaid by Herodotus; and if they add any thing of their own, it is but merely from conjecture. Dumont obſerves, that it is very probable, that aloes, bitumen, and cinnamon, make a principal part of the compoſition which is uſed on this occaſion: he adds, that after embalming, the body is put into a coffin, made of the ſycamore-tree, which is almoſt incorruptible. Mr. Grew remarks, that in an Egyptian mummy, in the poſſeſſion of the Royal Society, the preparation was ſo penetrating, as to enter into the very ſubſtance of the bones, and rendered them ſo black, that they ſeemed to have been burnt. From this he is induced to believe, that the Egyptians had a cuſtom of embalming their dead, by boiling them in a kind of liquid preparation, until all the aqueous parts of the body were exhaled away; and until the oily or gummy matter had penetrated throughout. He propoſes, in conſequence of this, a method of macerating, and afterwards of boiling the dead body in oil of walnut.

We are of opinion, that there were ſeveral ways of preſerving dead bodies from putrefaction; and that this would be no difficult matter, ſince different nations have all ſucceeded in the attempt. We have an example of this kind among the Guanches, the ancient inhabitants of the iſland of Teneriff. Thoſe who ſurvived the general deſtruction of this people, by the Spaniards, when they conquered this iſland, informed them, that the art of embalming was ſtill preſerved there; and that there was a tribe of prieſts among them, poſſeſſed of the ſecret, which they kept concealed as a ſacred

a ſacred myſtery. As the greateſt part of the nation was deſtroyed, the Spaniards could not arrive at a complete knowledge of this art: they only found out a few of the particulars. Having taken out the bowels, they waſhed the body ſeveral times in a lee made of the dried bark of the pine-tree, warmed, during the ſummer, by the ſun, or by a ſtove in the winter. They afterwards anointed it with butter, or the fat of bears, which they had previouſly boiled with odoriferous herbs, ſuch as ſage and lavender. After this unction, they ſuffered the body to dry, and then repeated the operation, as often as it was neceſſary, until the whole ſubſtance was impregnated with the preparation. When it was become very light, it was then a certain ſign that it was fit, and properly prepared. They then rolled it up in the dried ſkins of goats, which, when they had a mind to ſave expence, they ſuffered to remain with the hair ſtill growing upon them. Purchas aſſures us, that he has ſeen mummies of this kind in London; and mentions the name of a gentleman who had ſeen ſeveral of them in the iſland of Teneriff, which were ſuppoſed to have been two thouſand years old; but without any certain proofs of ſuch great antiquity. This people, who probably came firſt from the coaſts of Africa, might have learned this art from the Egyptians, as there was a traffic carried on from thence into the moſt internal parts of Africa.

Father Acoſta, and Garcilaſſo de la Vega, make no doubt but that the Peruvians underſtood the art of preſerving their dead for a very long ſpace of time. They aſſert their having ſeen the bodies of ſeveral Incas, that were perfectly preſerved. They ſtill preſerved their hair, and their eye-brows; but they had eyes, made of gold, put in the places of thoſe taken out. They were cloathed in their uſual habits, and ſeated in the manner of the Indians, their arms placed on their breaſts. Garcilaſſo touched one of their fingers, and found it apparently as hard as wood; and the whole body was not heavy enough to over-burthen a weak man, who ſhould attempt to carry it away. Acoſta preſumes, that theſe bodies were embalmed with a bitumen, of which the Indians knew the properties. Garcilaſſo, however, is of a different opinion, as he ſaw nothing bituminous about them; but he confeſſes, that he did not examine them very particularly; and he regrets his not having enquired into the methods uſed for that purpoſe. He adds, that, being a Peruvian, his countrymen would not have ſcrupled to inform him of the ſecret, if they really had it ſtill among them.

Garcilaſſo, thus being ignorant of the ſecret, makes uſe of ſome inductions, to throw light upon the ſubject: he aſſerts, that the air is ſo dry and ſo cold at Cuſco, that fleſh dries there like wood, without corrupting: and he is of opinion, that they dried the body in ſnow, before they applied the bitumen: he adds, that in the times of the Incas, they uſually dried the fleſh which was deſigned for the army; and that when they had loſt their humidity, they might be kept without ſalt, or any other preparation.

It is ſaid, that at Spitſbergen, which lies within the arctic circle, and, conſequently, in the coldeſt climate, bodies never corrupt, nor ſuffer any apparent alteration, even though buried for thirty years: nothing corrupts or putrefies in that climate; the wood which has been employed in building thoſe houſes where the train-oil is ſeparated, appears as freſh as the day they were firſt cut.

If exceſſive cold, therefore, be thus capable of preſerving bodies from corruption, it is not leſs certain, that a great degree of dryneſs, produced by heat, produces the ſame effect. It is well known, that the men and animals that are buried in the ſands of Arabia, quickly dry up, and continue in preſervation for ſeveral ages, as if they had actually been embalmed. It has often happened, that whole caravans have periſhed in croſſing thoſe deſerts, either by the burning winds that infeſt them, or by the ſands which are raiſed by the tempeſt, and overwelm every creature in certain ruin. The bodies of thoſe perſons are preſerved entire; and they are often found in this condition by ſome accidental paſſenger. Many authors, both ancient and modern, make mention of ſuch mummies as theſe: and Shaw ſays, that he has been aſſured, that numbers of men, as well as other animals, have been thus preſerved for times immemorial, in the burning ſands of Saibah, which is a place, he ſuppoſes, ſituate between Raſem and Egypt.

The corruption of dead bodies being entirely cauſed by the fermentation of the humours, whatever is capable of hindering or retarding this fermentation, will contribute to their preſervation. Both heat and cold, though ſo contrary in themſelves, produce ſimilar effects in this particular, by drying up the humours. The cold in condenſing and thickening them, and the heat in evaporating them before they have time to act upon the ſolids. But it is neceſſary that theſe extremes ſhould be conſtant; for if they ſucceed each other ſo as that cold ſhall follow heat, or dryneſs humidity, it muſt then neceſſarily happen, that corruption muſt enſue. However, in temperate climates, there are natural cauſes capable of preſerving dead bodies; among which we may reckon the qualities of the earth in which they are buried. If the earth be drying and aſtringent, it will imbibe the humidity of the body; and it may be probably for this reaſon that the bodies buried in the monaſtery of the Cordeliers, at Thouloufe, do not putrefy, but dry in ſuch a manner that they may be lifted up by one arm.

The gums, reſins, and bitumens, with which dead bodies are embalmed, keep off the impreſſions which they would elſe receive from the alteration of the temperature of the air; and ſtill more, if a body thus prepared be placed in a dry or burning ſand, the moſt powerful means will be united for its preſervation. We are not to be ſurpriſed, therefore, at what we are told by Chardin, of the country of Choroſan, in Perſia. The bodies which have been previouſly embalmed, and buried in the ſands of that country, as he aſſures us, are found to petrify, or, in other words, to become extremely hard, and are preſerved for ſeveral ages. It is aſſerted that ſome of them have continued for a thouſand years.

The Egyptians, as has been mentioned above, ſwathed the body with linen bands, and encloſed it in a coffin; however, it is probable that, with all theſe precautions, they would not have continued till now, if the tombs, or pits, in which they were placed, had not been dug in a dry chalky ſoil, which was not ſuſceptible of humidity; and which was, beſides, covered over with a dry ſand of ſeveral feet thickneſs.

The ſepulchres of the antient Egyptians ſubſiſt to this day. Moſt travellers who have been in Egypt, have deſcribed thoſe of antient mummies, and have ſeen the mummies interred there. Theſe catacombs are within two leagues of the ruins of this city, nine leagues from Grand Cairo, and about two miles from the village of Zaccara. They extend from thence to the pyramids of Pharaoh, which are about eight miles diſtant. Theſe ſepulchres lie in a field, covered with a fine running ſand, of a yellowiſh colour. The country is dry and hilly; the entrance of the tomb is choaked

choaked up with ſand; there are many open, but ſeveral more that are ſtill concealed. The inhabitants of the neighbouring village have no other commerce, or method of ſubſiſting, but by ſeeking out mummies, and ſelling them to ſuch ſtrangers as happen to be at Grand Cairo. This commerce, ſome years ago, was not only a very common, but a very gainful one. A complete mummy was often ſold for twenty pounds; but it muſt not be ſuppoſed that it was bought at ſuch an high price from a mere paſſion for antiquity; there were much more powerful motives for this traffic. Mummy at that time made a conſiderable article in medicine; and a thouſand imaginary virtues were aſcribed to it, for the cure of moſt diſorders, particularly of the paralytic kind. There was no ſhop, therefore, without mummy in it; and no phyſician thought he had properly treated his patient, without adding this to his preſcription. Induced by the general repute, in which this ſuppoſed drug was at that time, ſeveral Jews, both of Italy and France, found out the art of imitating mummy ſo exactly, that they, for a long time, deceived all Europe. This they did by drying dead bodies in ovens, after having prepared them with myrrh, aloes, and bitumen. Still, however, the requeſt for mummies continued, and a variety of cures were daily aſcribed to them. At length, Paræus wrote a treatiſe on their total inefficacy in phyſic; and ſhewed their abuſe in loading the ſtomach, to the excluſion of more efficacious medicines.

From that time, their reputation began to decline; the Jews diſcontinued their counterfeits, and the trade returned entire to the Egyptians, when it was no longer of value. The induſtry of ſeeking after mummies is now totally relaxed, their price merely arbitrary, and juſt what the curious are willing to give.

In ſeeking for mummies, they firſt clear away the ſand, which they may do for weeks together, without finding what is wanted. Upon coming to a little ſquare opening, of about eighteen feet in depth, they deſcend into it, by holes for the feet, placed at proper intervals; and there they are ſure of finding what they ſeek for. Theſe caves, or wells, as they call them, are hollowed out of a white freeſtone, which is found in all this country a few feet below the covering of ſand.

When one gets to the bottom of theſe, which are ſometimes forty feet below the ſurface, there are ſeveral ſquare openings, on each ſide, into paſſages of ten or fifteen feet wide, and theſe lead to chambers of fifteen or twenty feet ſquare. Theſe are all hewn out of the rock; and in each of the catacombs are to be found ſeveral of theſe apartments, communicating with each other. They extend a great way under ground, ſo as to be under the city of Memphis, and in a manner to undermine its environs.

In ſome of the chambers, the walls are adorned with figures and hieroglyphics; in others, the mummies are found in tombs, round the apartment hollowed out in the rock. Theſe tombs are upright, and cut into the ſhape of a man, with his arms ſtretched out. There are others found, and theſe in the greateſt number, in wooden coffins, or in cloths covered with bitumen. Theſe coffins, or wrappers, are covered all over with a variety of ornaments. There are ſome of them painted, and adorned with figures, ſuch as that of death, and the leaden ſeals, on which ſeveral characters are engraven.

Some of theſe coffins are carved into the human ſhape; but the head alone is diſtinguiſhable; the reſt of the body is all of a piece, and terminated by a pedeſtal, while there are ſome with their arms hanging down; and it is by theſe marks that the bodies of perſons of rank are diſtinguiſhed from thoſe of the meaner order. Theſe are generally found lying on the floor, without any profuſion of ornaments; and in ſome chambers the mummies are found indiſcriminately piled upon each other, and buried in the ſand.

Many mummies are found lying on their backs; their heads turned to the north, and the hands placed on the belly. The bands of linen, with which theſe are ſwathed, are found to be more than a thouſand yards long; and, of conſequence, the number of circumvolutions they make about the body muſt have been amazing. Theſe were performed by beginning at the head, and ending at the feet; but they contrived it ſo as to avoid covering the face. However, when the face is entirely uncovered, it moulders into duſt immediately upon the admiſſion of the air. When, therefore, it is preſerved entire, a ſlight covering of cloth is ſo diſpoſed over it, that the ſhape of the eye, the noſe, and the mouth, are ſeen under it. Some mummies have been found with a long beard, and hair that reached down to the mid-leg, nails of a ſurpriſing length, and ſome gilt, or at leaſt painted of a gold colour. Some are found with bands upon the breaſt, covered with hieroglyphics, in gold, ſilver, or in green; and ſome with tutelary idols, and other figures of jaſper, within their body. A piece of gold, alſo, has often been found under their tongues, of about two piſtoles value; and, for this reaſon, the Arabians ſpoil all the mummies they meet with, in order to get at the gold.

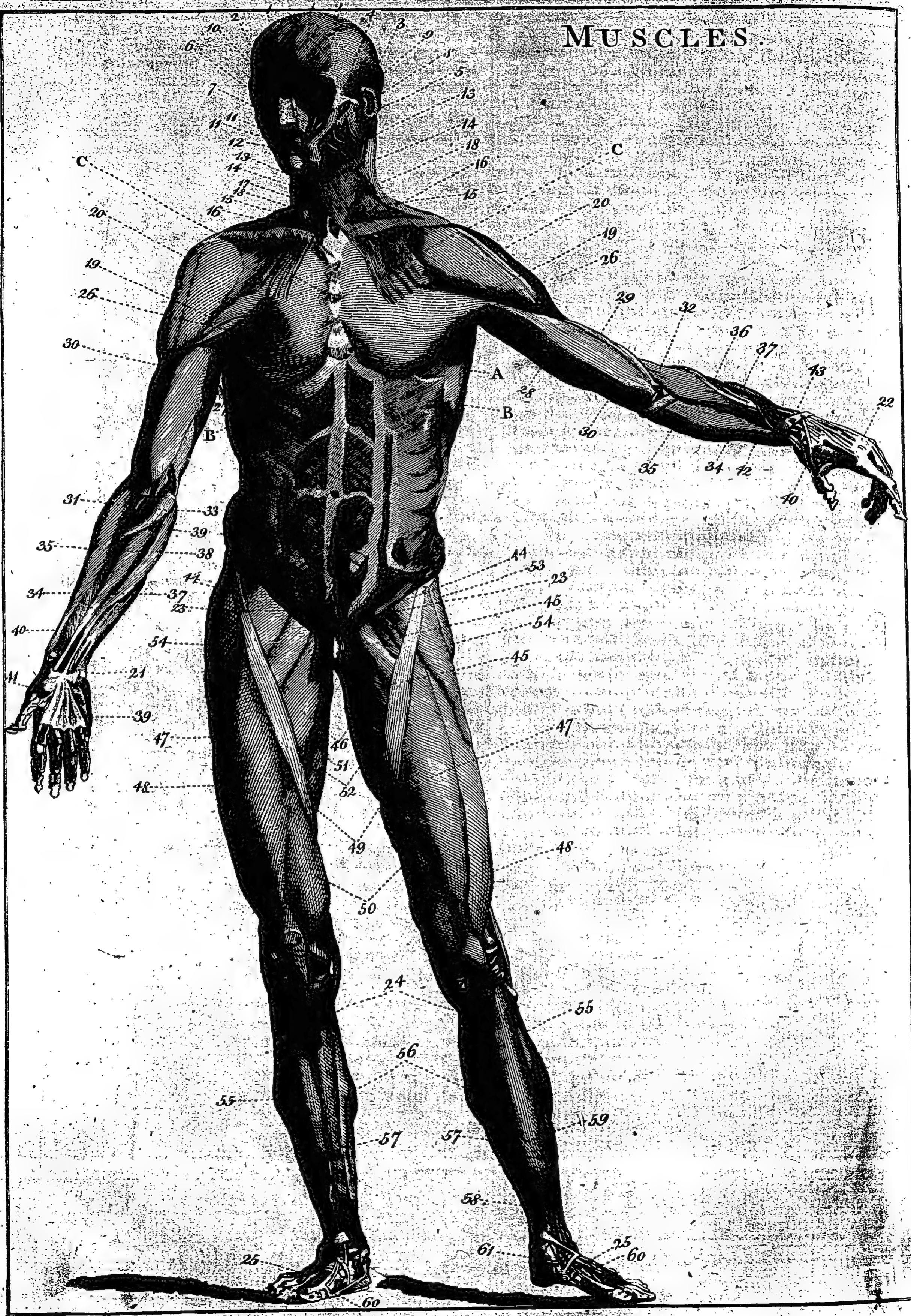
But, although art, or accident, has thus been found to preſerve dead bodies entire, it muſt by no means be ſuppoſed that it is capable of preſerving the exact form and lineaments of the deceaſed perſon. Thoſe bodies which are found dried away in the Deſerts, or in ſome particular church-yards, are totally deformed, and ſcarce any lineaments remain of their external ſtructure. Nor are the mummies preſerved by embalming, in a better condition. The fleſh is dried away, hardened, and hidden under a variety of bandages; the bowels, as we have ſeen, are totally removed; and from hence, in the moſt perfect of them, we ſee only a ſhapeleſs maſs of ſkin diſcoloured; and even the features ſcarce diſtinguiſhable. The art is, therefore, an effort rather of perſerving the ſubſtance than the likeneſs of the deceaſed; and has, conſequently, not been brought to its higheſt pitch of perfection. It appears from a mummy, not long ſince dug up in France, that the art of embalming was more completely underſtood in the weſtern world than even in Egypt. This mummy, which was dug up at Auvergne, was an amazing inſtance of their ſkill, and is one of the moſt curious relicks in the art of preſervation. As ſome peaſants, in that part of the world, were digging in a field near Rion, within about twenty-ſix paces of the highway, between that and the river Artier, they diſcovered a tomb, about a foot and a half beneath the ſurface. It was compoſed only of two ſtones; one of which formed the body of the ſepulchre, and the other the cover. This tomb was of free-ſtone; ſeven feet and a half long, three feet and a half broad, and about three feet high. It was of rude workmanſhip; the cover had been poliſhed, but was without figure or inſcription: within this tomb was placed a leaden coffin, four feet ſeven inches long, fourteen inches broad, and fifteen high. It was not made in the form of a coffin, but oblong, like a box, equally broad at both ends, and covered with a lid that fitted on like a ſnuff-box, without an hinge. This cover had two holes in it, each of about

about two inches long, and very narrow, filled with a ſubſtance reſembling butter; but for what purpoſe intended remains unknown. Within this coffin was a mummy, in the higheſt and moſt perfect preſervation. The internal ſides of the coffin were filled with an aromatic ſubſtance, mingled with clay. Round the mummy was wrapped a coarſe cloth, in form of a napkin, under this were two ſhirts, or ſhrouds, of the moſt exquiſite texture; beneath theſe a bandage, which covered all parts of the body, like an infant in ſwaddling cloaths; ſtill, under this general bandage there was another, which went particularly round the extremities, the hands and the legs. The head was covered with two caps; the feet and hands were without any particular bandages; and the whole body was covered with an aromatic ſubſtance, an inch thick. When theſe were removed, and the body expoſed naked to view, nothing could be more aſtoniſhing than the preſervation of the whole, and the exact reſemblance it bore to a body that had been dead a day or two before. It appeared well proportioned, except that the head was rather large, and the feet ſmall. The ſkin had all the pliancy and colour of a body lately dead; the viſage, however, was of a browniſh hue. The belly yielded to the touch; all the joints were flexible; except thoſe of the legs and feet; the fingers ſtretched forth of themſelves when bent inwards. The nails ſtill continued entire; and all the marks of the joints, both in the fingers, the palms of the hands, and the ſoles of the feet, remained perfectly viſible. The bones of the arms and legs were ſoft and pliant; but, on the contrary, thoſe of the ſkull preſerved their rigidity; the hair, which only covered the back of the head, was of a cheſnut colour, and about two inches long. The pericranium at top was ſeparated from the ſkull, by an inciſion, in order to open it for the introducing proper aromatics in the place of the brain, where they were found mixed with clay. The teeth, the tongue, and the ears, were all preſerved in perfect form. The inteſtines were not taken out of the body, but remained pliant and entire, as in a freſh ſubject; and the breaſt was made to riſe and fall like a pair of bellows. The embalming preparation had a very ſtrong and pungent ſmell, which the body preſerved for more than a month after it was expoſed to the air. This odour was perceived wherever the mummy was laid; although it remained there but a very ſhort time, it was even pretended that the peaſants of the neighbouring villages were incommoded by it. If one touched either the mummy, or any part of the preparation, the hands ſmelt of it ſeveral hours after, although waſhed with water, ſpirit of wine, or vinegar. This mummy, having remained expoſed for ſome months to the curioſity of the public, began to ſuffer ſome mutilations. A part of the ſkin of the forehead was cut off; the teeth were drawn out, and ſome attempts were made to pull away the tongue. It was, therefore, put into a glaſs-caſe, and ſhortly after tranſmitted to the king of France's cabinet, at Paris.

There are many reaſons to believe this to be the body of a perſon of the higheſt diſtinction; however, no marks remain to aſſure us either of the quality of the perſon, or the time of his deceaſe. There only are to be ſeen ſome irregular figures on the coffin; one of which repreſents a kind of ſtar. There were alſo ſome ſingular characters upon the bandages, which were totally defaced by thoſe who had torn them away. However, it ſhould ſeem that it had remained for ſeveral ages in this ſtate, ſince the firſt years immediately ſucceeding the interment, are uſually thoſe in which the body is moſt liable to decay. It appears alſo to be a much more perfect method of embalming than that of the Egyptians; as in this the fleſh continues with its natural elaſticity and colour, the bowels remain entire, and the joints have almoſt the pliancy which they had when the perſon was alive. Upon the whole, it is probable that a much leſs tedious preparation than that uſed by the Egyptians would have ſufficed to keep the body from putrefaction; and that an injection of petreoleum inwardly, and a layer of aſphaltum without, would have ſufficed to have made a mummy; and it is remarkable that Auvergne, where this was found, affords theſe two ſubſtances in ſufficient plenty. This art, therefore, might be brought to greater perfection than it has arrived at hitherto, were the art worth preſerving. But mankind have long ſince grown wiſer in this reſpect, and think it unneceſſary to keep by them a deformed carcaſs, which, inſtead of aiding their magnificence, muſt only ſerve to mortify their pride.

APPENDIX.

MUSCLES.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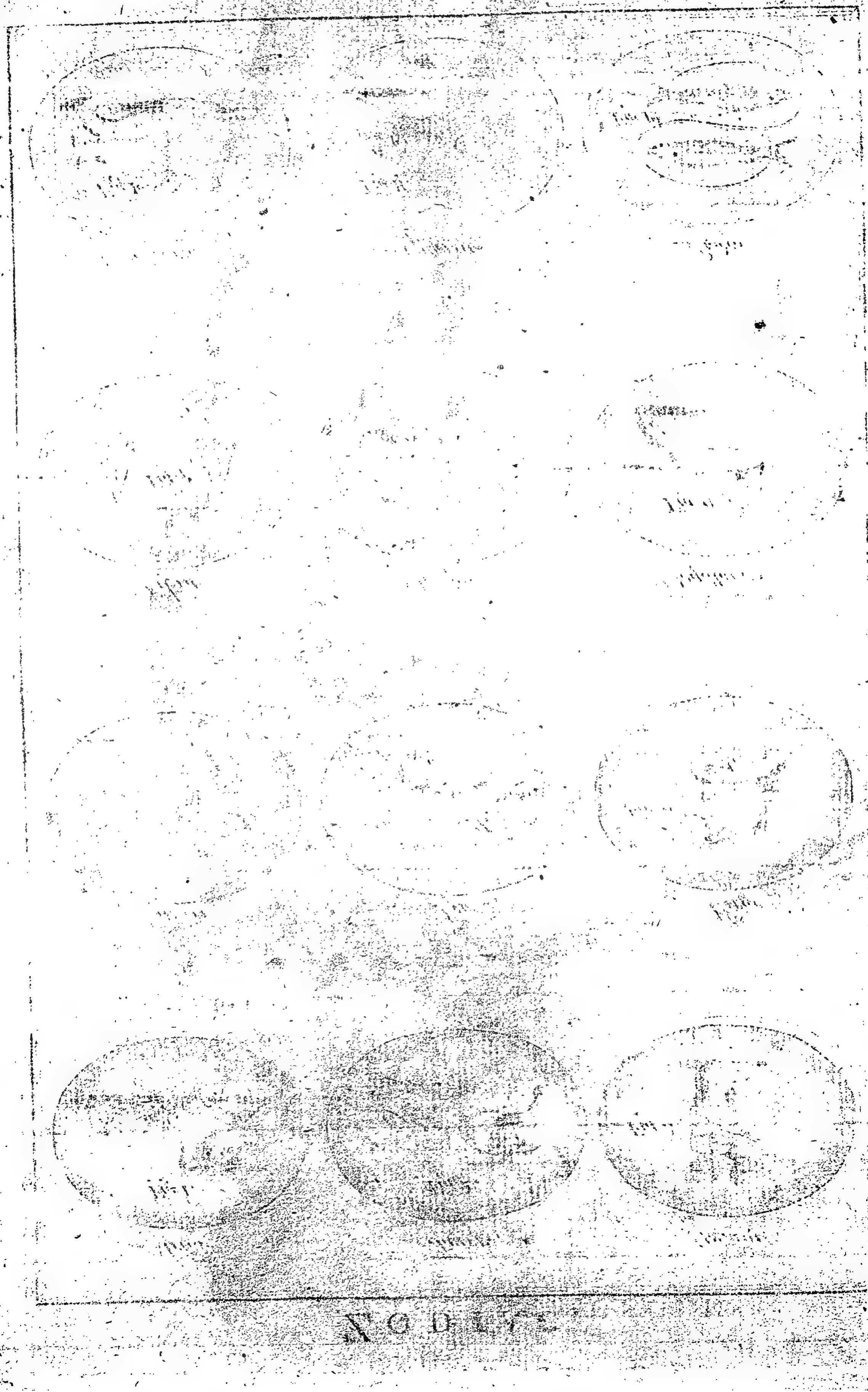

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Aries

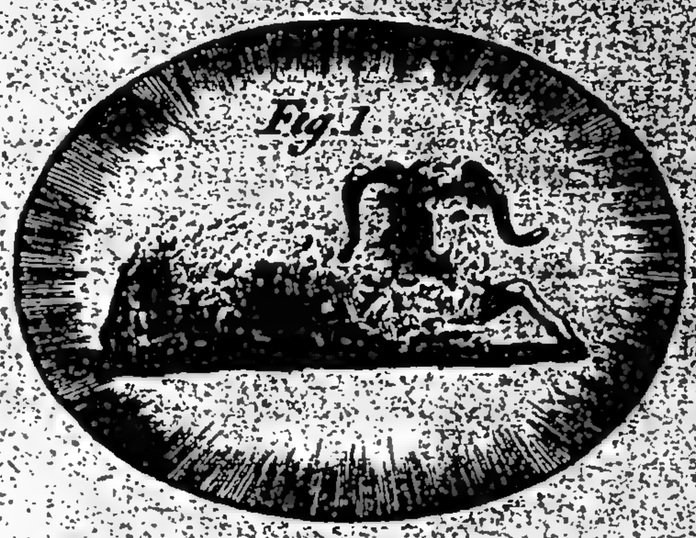

Fig. 1.

Taurus

Fig. 2.

Gemini

Fig. 3.

Cancer

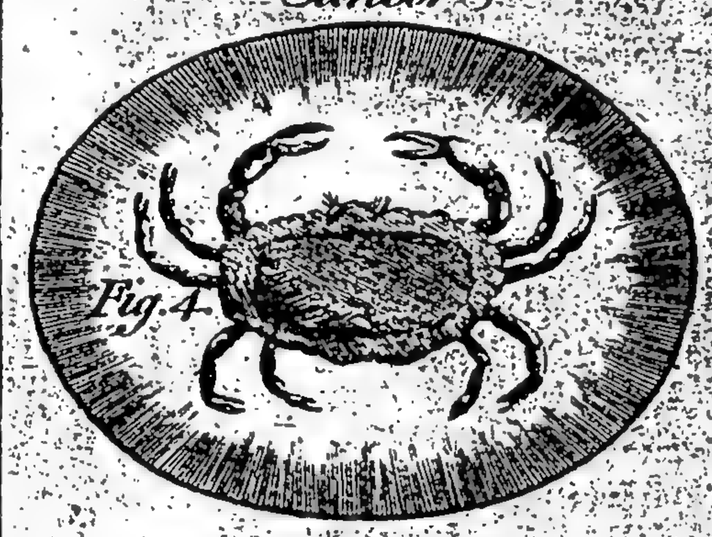

Fig. 4.

Leo

Fig. 5.

Virgo

Fig. 6.

Libra

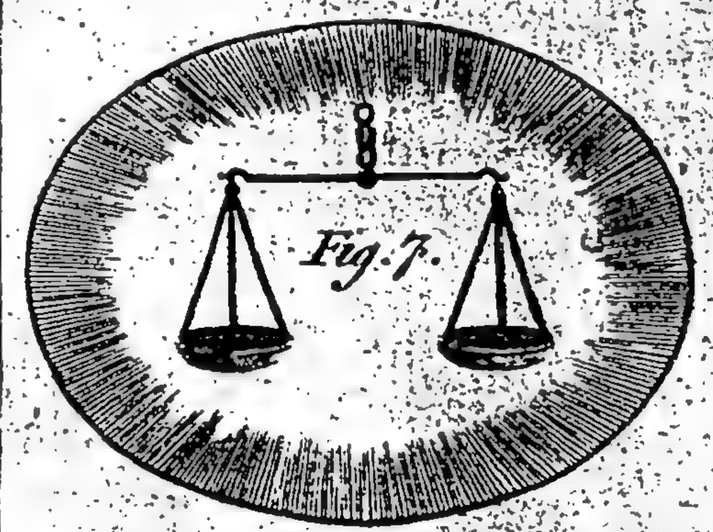

Fig. 7.

Scorpio

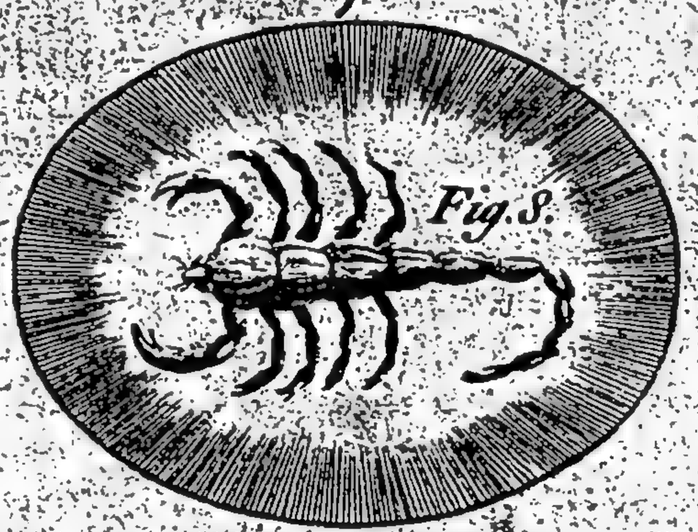

Fig. 8.

Sagittarius

Fig. 9.

Capricornus

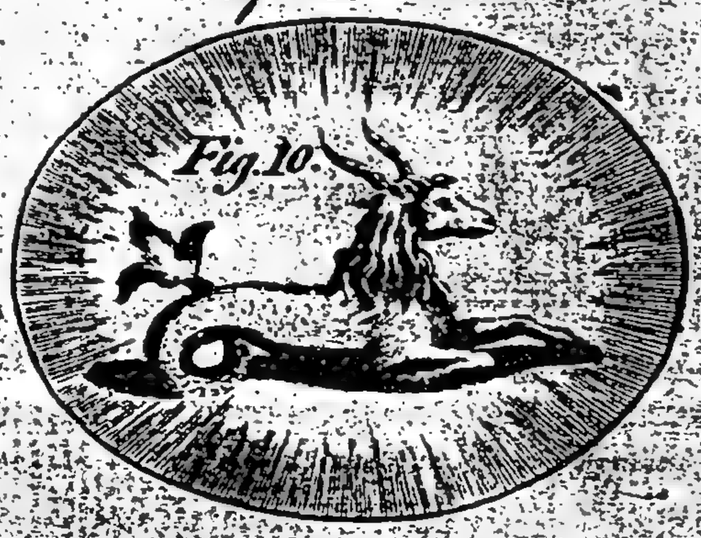

Fig. 10.

Aquarius

Fig. 11.

Pisces

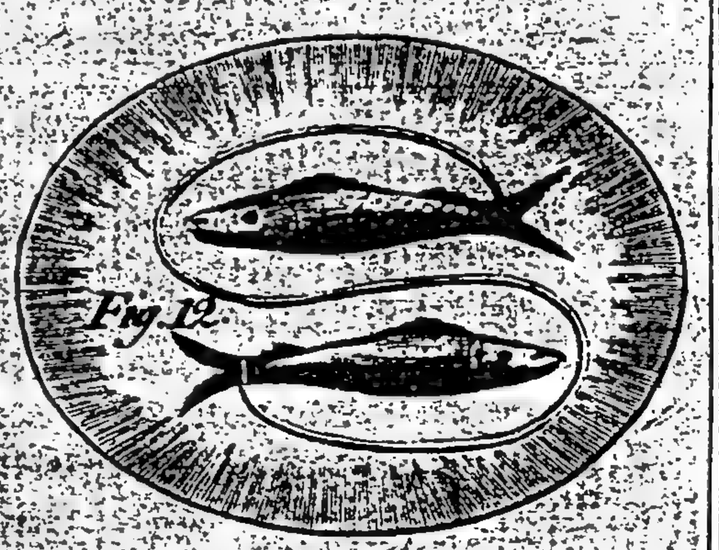

Fig. 12.

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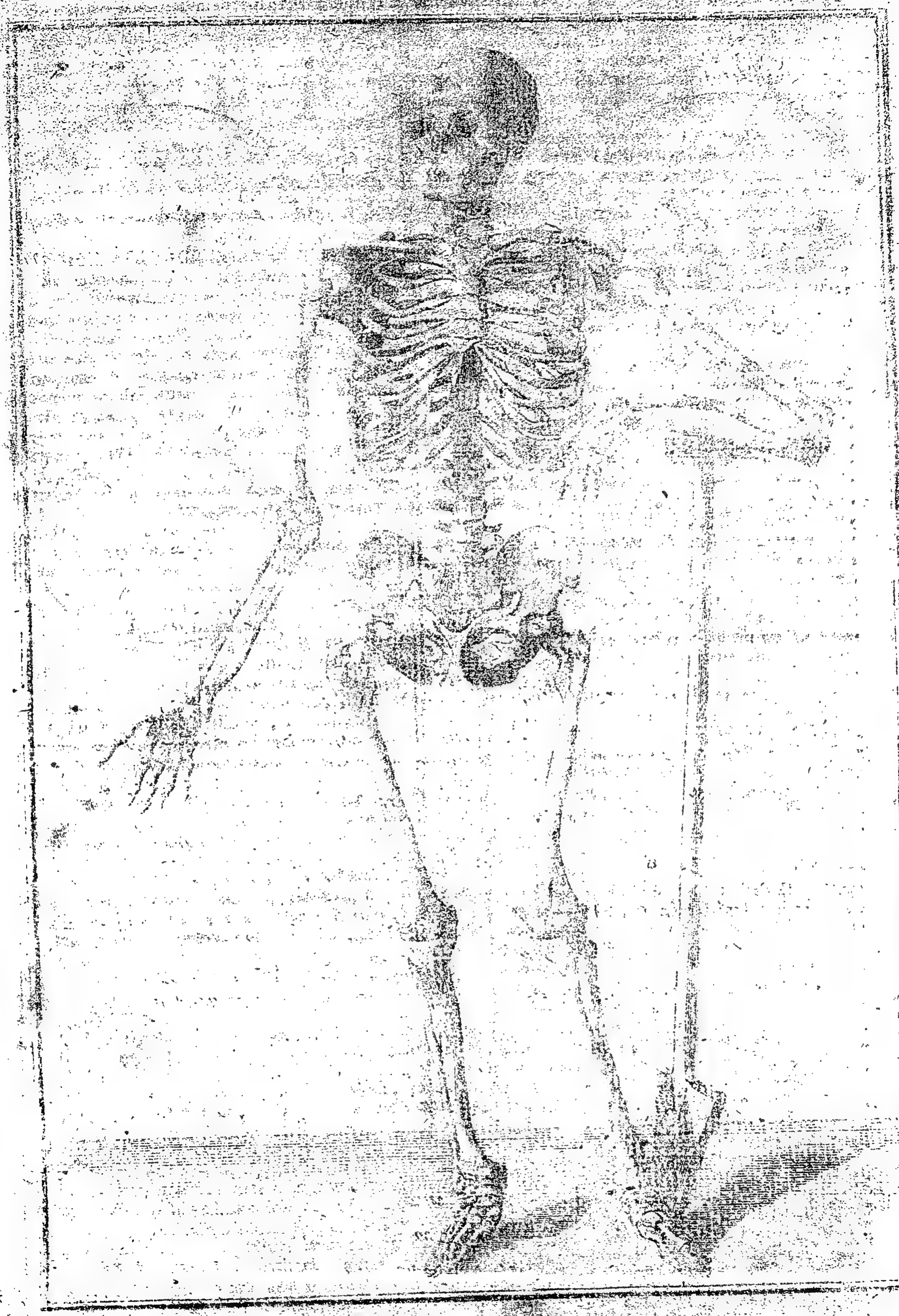

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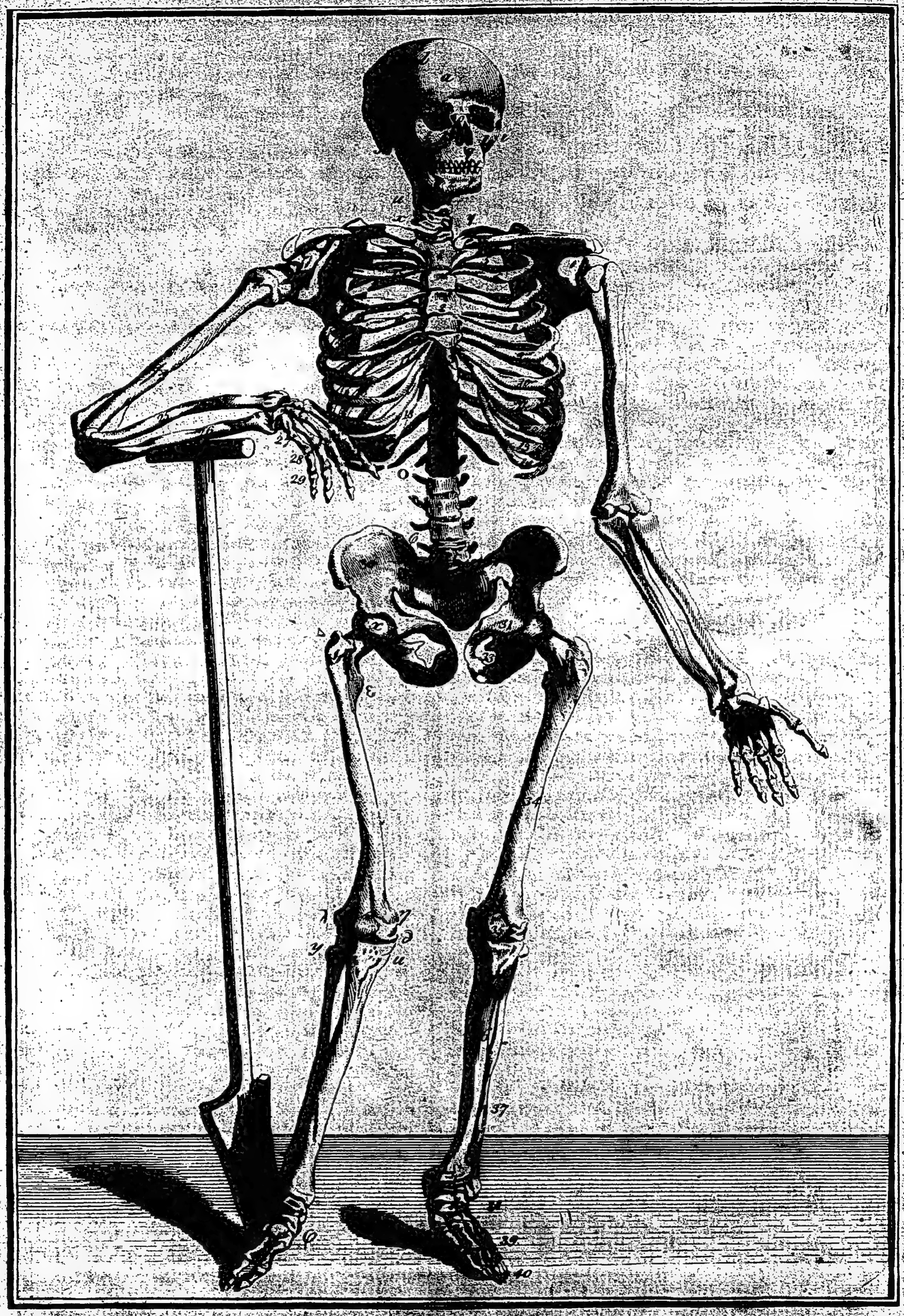
SKELETON.



Published by Alex. Hogg at the Kings arms No. 16 Paternoster Row.

APPENDIX.

In our SKETCH of the UNIVERSE, in Page 477, the Printer having omitted to mention our Plate containing the twelve Signs of the Zodiac—we shall here insert the following Explanation:

THE ZODIACK is one of the greateſt imaginary circles of the heavens, which paſſes obliquely between the two poles of the world; it is cut into two equal parts, by the equator, one of which comprehends the ſix northern ſigns towards the Arctick pole, and the other the ſix ſouthern ſigns towards the Antarctick pole; it is furniſhed with twelve conſtellations repreſented upon globes, by the figure of twelve living creatures. The ſun goes about this circle once every year, and the moon once a month, and in the middle of it is the Ecliptick line, from which the ſun never departs; but the moon and planets wander up and down from the ſpace of eight degrees, and ſometimes more in both.

Figure 1. Shews ARIES, a conſtellation in the heavens repreſented by a ram, which is the firſt ſign of the zodiack. The number of ſtars in this conſtellation, are 18 in Ptolemy's catalogue, 21 in Tycho's, and 65 in Mr. Flamſtead's.

Fig. 2. Is TAURUS, the bull, and is thus characteriſed, ♉. The ſtars in the conſtellation Taurus, in Ptolemy's catalogue, are 44; in Tycho's catalogue, 41; in the Britannick catalogue, 135.

Fig. 3. Is GEMINI, *the Twins*, repreſented by two beautiful children, embracing and looking very affectionately in the face of each other, and is thus marked ♊.

The poets ſay they repreſent Caſtor and Pollux, ſons to Jupiter and Leda. The ſtars of Gemini in Ptolemy's catalogue contain 24; in Tycho's 29; in the Britannick catalogue 89.

Fig. 4. Is CANCER, repreſented on the globe in the form of a crab, and thus marked, ♋. Ptolemy makes it contain only 13 ſtars; Tycho Brahe 15; Bayer and Hevelius 29; and Flamſtead no leſs than 71.

Fig. 5. Is LEO, containing, according to Ptolemy, 32 ſtars; according to Tycho, 37; and according to Flamſtead, 94.

The famous ſtar of the firſt magnitude, called baſilicus, regulus, cor leonis, or the lion's heart, is in this conſtellation.

Fig. 6. Is VIRGO, in which the ſun enters in the middle of Auguſt. The ſtars in the conſtellation Virgo, in Ptolemy's catalogue, are 32; in Tycho's 39; in the Britannick, 89.

Fig. 7. Is LIBRA, or the balance, ſo called, becauſe when the ſun enters it, the days and nights are equal, as if weighed in a balance.

Fig. 8. Is SCORPIO, *Scorpion*, denoted by this character. ♏. The ſtars in Scorpio, in Ptolemy's catalogue, are 20; in that of Tycho, 10; but in that of Mr. Flamſtead, 49.

Fig. 9. Is SAGITTARIUS, the archer, marked thus, ♐. The ſtars in this conſtellation in Ptolemy's catalogue are 31, in Tycho's 16, and in Mr. Flamſtead's 52.

Fig. 10. Is CAPRICORNUS, or *Capricorn*, repreſented on the globe in the form of a goat, with a fiſh's tail. It is marked thus, ♑. According to Ptolemy and Tycho, it contains 19 ſtars, according to Hevelius 29, and according to Flamſtead 51.

This conſtellation is very properly repreſented by the wild goat, whoſe nature being to ſeek its food from the bottom to the top of mountains, climbing from rock to rock, fitly emblemized the aſcent of the ſun, from the loweſt point, in the beginning of this ſign to its higheſt pitch or ſummit, in the ſummer ſolſtice.

Fig. 11. Is AQUARIUS, a conſtellation, marked thus, ♒. This conſtellation, conſiſts of 45 ſtars in Ptolemy's catalogue, of 40 in Tycho's, and in Mr. Flamſtead's of 108.

Fig. 12. Is PISCES, marked thus, ♓. The ſtars in Piſces, in Ptolemy's catalogue, are 38; in Tycho's, 33; and in the Britannick catalogue, 109.

In our NATURAL HISTORY of MAN have been alſo omitted, Explanations of ſeveral Plates belonging to this Work. We ſhall therefore give them as follow:

Explanation of the Plate repreſenting the Skeleton of the Human Body.

a, The frontal bone. *b*, The coronal ſuture. *c*, The parietal bone. *d*, The occipital ſuture. *e*, The temporal bone. *f*, The maſtoide apophyſis. *g*, The zygomatical apophyſis. *h*, The temporal apophyſis. *i*, *i*, The bones of the cheek. *k*, The external part of the bone that lines the orbits of the eye. *l*, The os planum. *m*, The os unguis. *n*, The upper apophyſis of the maxillary bone. *o*, The bone of the noſe. *p*, The partition of the noſe. *q*, *q*, The maxillary bone. *r*, *r*, The lower jaw. *s*, The orbit of the eye. *t*, The inferior part of the orbit. *u*, The fifth vertebræ of the neck. *x*, The ſixth. *y*, The hole of their tranſverſe apophyſis. *z*, The chin. 1, 2, 3, The ſternum. 4, The clavicles. 5, 6, 7, 8, 9, 10, 11, The true ribs. 12, 13, 14, The falſe ribs. 15, 16, 17, 18, The cartilages which unite the true ribs to the ſternum. 19, The laſt vertebræ of the back. 20, 21, The five vertebræ of the loins. *a*, *a*, Their tranſverſe apophyſis. 22, 22, The os ſacrum. *c*, *c*, The orifice of the os ſacrum. 23, The amoplata. 24, The humerus, or bone of the arm. 25, The radius. 26, The os cubitus. 27, The carpus. 28, The metacarpus. 29, The phalanges, or bones of the fingers. 30, The os ilium. 31, The os pubis. 32, The os iſchium. Theſe three laſt bones compoſe the oſſa innominata. 33, The foramen ovale. 34, The os femoris. *e*, Its head. *f*, Its neck. Δ, The great trochanter. *i*, the little trochanter. *n*, The internal condyle. *o*, The external condyle. 35, The rotula. 36, The tibia. *r*, The external condyle. *s*, The internal condyle. *t*, The ligament of rotula. *v*, The malleolus internus. 37, The fibula. *x*, The malleolus externus. 38, The tarſus. 39, The metatarſus. 40, The phalanges of the toes.

Explanation of the Plate repreſenting a Front View of the Muſcles.

1, 1, The muſculi frontales. 2, 2, The orbicularis palpebrarum. 3, The attollens auriculam.

4, The temporalis. 5, The maſſeter. 6, Repreſents the muſcle called by Lanciſi conſtrictor, or depreſſor pinnæ narium. 7, The dilatator alæ naſi. 8, The zygomaticus. 9, The place of the elevator labiorum, or elevator labiorum communis, called by Lanciſi gracilis. 10, The elevator labii ſuperioris proprius. 11, 11, The conſtrictor or ſphincter labiorum, or orbicularis labiorum; by ſome called oſculatorius. 12, The buccinator. 13, 13, The muſculi maſtoidæi. 14, 14, The ſternohyoidei. 15, 15, Thoſe parts of theſe muſcles which ariſe from the clavicle. 16, 16. The coracohyoidei. 17, The ſcaleni. 18, Repreſents part of the cucullaris on the right ſide. 18, On the left ſide is the levator or elevator ſcapulæ, otherwiſe called muſculus patientiæ. 19, 19, The place where the fibres of the pectoralis unite, in ſome meaſure, with thoſe of the deltoides. 20, 20, The deltoides. 21, The place in the carpus, where the palmaris longus paſſes through a ring in the annular ligament. 22, A remarkable union of the tendons of the extenſors of the three laſt fingers. 23, 23, The productions of the peritonæum, which, perforating the muſcles of the abdomen at the rings deſcend to the ſcrotum. 24, 24, The place where the three tendons of the ſartorius, gracilis, and ſeminervoſus are inſerted into the anterior and internal part of the tibia, juſt under the knee. 25, 25, The tendons of the extenſors of the toes, which are ſecured by a ligament at the ancle, as appears on both ſides. But on the right ſide internally another ligament is repreſented, which fixes the tendons of the extenſor longus digitorum, the tibiæus poſticus, and the flexor pollicis. 26, 26, The muſculus pectoralis. 27, The triceps extenſor cubiti on the right ſide. 28, and 30, The biceps on the left ſide, according to Lanciſi's explication. 29, Part of the triceps extenſor on the left ſide. 30, The biceps on the right ſide. 31, The brachiæus internus. 32, The anconæus. 33, The pronator rotundus. 34, 34, The ſupinator longus. 35, 35, The radius externus, according to Lanciſi. 36, The extenſor carpi ulnaris. 37, 37, The cubitænus interus, according to Lanciſi. 38, The radius internus, according to Lanciſi. 39, The palmaris, with its tendinous expanſion. 40, 40, The tendons of the muſcles of the thumb. 41, The tendon of the adductor pollicis. 42, The extenſor magnus digitorum. 43, Ligamentum carpi. 44, 44, The tendons of the iliaci interni. 45, The pectinæus. 46, One of the heads of the triceps. 47, 47, The rectus femoris on each ſide. 48, 48, The vaſtus externus on each ſide. 49, The vaſtus internus on each ſide. 50, The gracilis. 51, The ſeminervoſus. 52, The ſartorius on each ſide. 53, A part of the origin of the vaſtus externus. 54, 54, The membranoſus. 55, 55, The tibialis anticus. 56, The gemelli. 57, 57, The ſolæi. 58, The tendo Achillis. 59, According to Lanciſi, is the extenſor digitorum longus. 60, 60, The tendons of the extenſors of the toes. 61, The tendons of the extenſor longus, tibiæus, poſticus, and flexor pollicis. A, A, Portions of the latiſſimus dorſi on each ſide. B, B, The indentations of the ſerratus major anticus. C, C, The ſternum.

Explanation of the Plate repreſenting a Back View of the Muſcles.

1, Two muſcles upon the occiput called by Euſtachius quadrati. 2, The muſculus cucullaris. 3, The ſplenius. 4, The muſculus maſtoidæus. 5, The muſculus patientiæ, or levator ſcapulæ proprius. 6, The rhomboides. 7, The articulation of the clavicle with the ſcapula on the right ſide. 8, The deltoides. 9, The teres minor. 10, The teres major. 11, 11, The latiſſimus dorſi on each ſide. 12, The glutæus major. 13, The glutæus medius. 14, The muſculus pyriformis. 15, The quadratus femoris. 16, The biceps femoris. 17, The ſemi-membranoſus. 18, The membranoſus, according to Lanciſi. 19, 19, The vaſti externi. 20, The gaſtrocnemii. 21, The ſoleus. 22, The plantaris.

Explanation of the Plate of Arteries.

Fig. 1. Will give a much better idea of the arteries of the human body, than is poſſible to be conveyed by words.

1. The aorta cut from its origin at the left ventricle of the heart. *Fig.* 3. of the ſame plate, repreſents part of the trunk of the aorta turned inſide out; *a*, *a*, the internal, or nervous coat; *b*, *b*, the muſcular coat; *c*, the external, or vaſcular coat.

A. The three ſemi-lunar valves of the aorta, as they appear when they hinder the blood from coming back into the left ventricle of the heart, in its diaſtole.

2. 2. The trunk of the coronary arteries ariſing from the aorta.

3. Ligamentum arterioſum.

4. 4. The ſubclavian arteries.

5. 5. The two carotid arteries.

6. 6. The two vertebral arteries, which ariſe from the ſubclavicula, and paſs through all the tranſverſe proceſſes of the vertebræ of the neck.

7. 7. The arteries which convey blood to the lower part of the face, tongue, adjacent muſcles and glands.

8. 8. The trunks of the temporal arteries, ſpringing from the carotids, and giving branches to the parotid glands.

9. 9. Branches of the temporal arteries, conveying blood to the neighbouring muſcles, the hairy ſcalp, and forehead.

10. 10. The trunks which ſend blood to the foramina narium, particularly to the glands of its mucous membranes.

11. 11. The occipital arteries, whoſe trunks paſs cloſe by the mamiform proceſs.

12. 12. Muſcles which carry blood to the fauces, gargareon, and muſcles of thoſe parts.

B. B. Small portions of the baſis of the ſkull, perforated by the artery of the dura mater, part of which is repreſented as hanging to the arteries.

13. 13. The contortions of the carotid arteries before they paſs the baſis of the ſkull to the brain.

14. 14. Theſe parts of the carotid arteries, where they paſs by each ſide of the ſella turcica, where ſeveral ſmall branches ariſe from them, and help to compoſe the retre mirabile.

C. The glandula pituitaria, taken out of the ſella turcica, lying between the two contorted trunks of the carotid arteries, marked 14. 14.

D. D. The arteriæ ophthalmicæ, which ſpring from the carotids before they enter the pia mater.

15. The contortions of the vertebral arteries, as they paſs the tranſverſe proceſſes of the firſt vertebre of the neck, towards the os occipitis.

16. The two trunks of the vertebral arteries that lie on the medulla oblongata.

17. The communicant branches between the carotid and cervical artery.

18. 18. The rammifications of the arteries within the ſkull, the larger trunks of which lie between the lobes of the brain, and its fulci.

E. E. The arteries of the cerebellum.

19. 19. The arties of the larynx; thyroid glands and adjacent muſcles and parts ariſing from the ſubclavian arteries.

20. 20. Others ariſing near the former, which convey blood to the muſcles of the neck and ſcapula.

21. 21. The

ARTERIES.

Fig. 1.

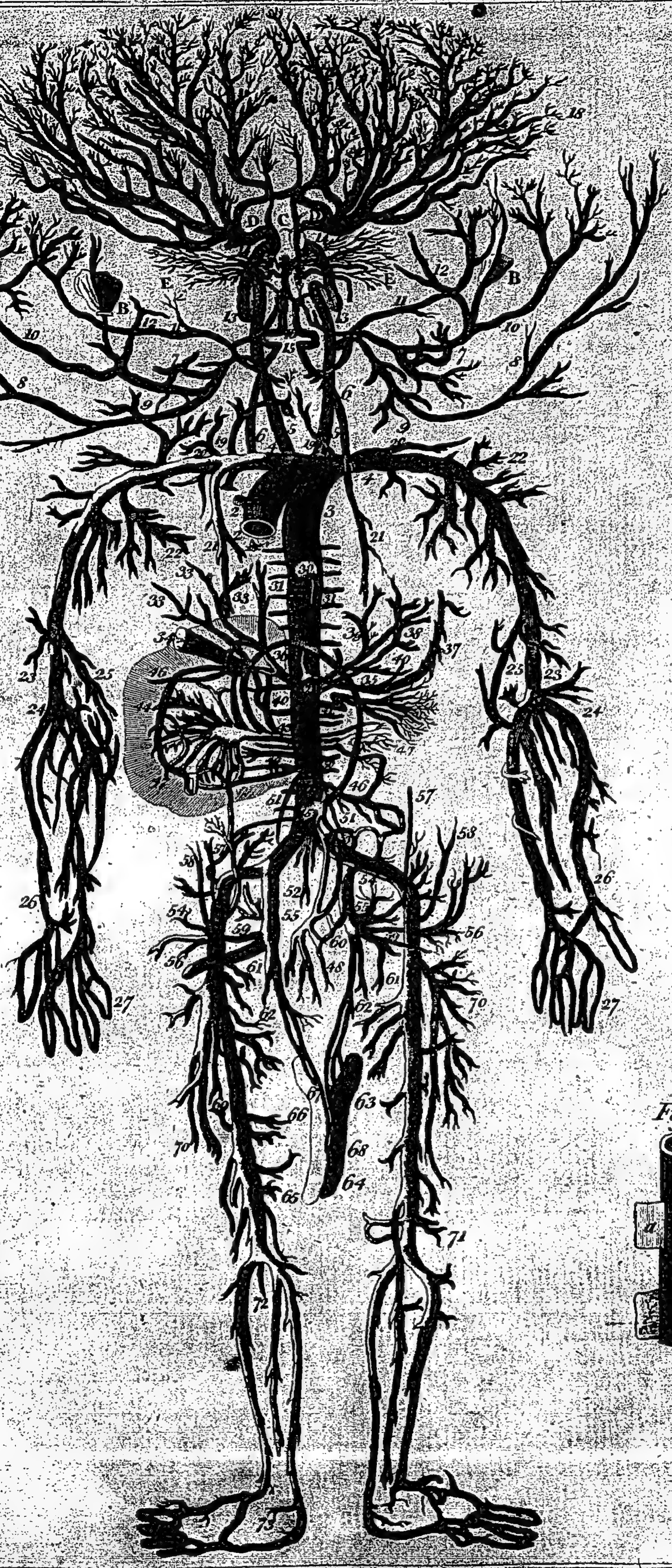


Fig. 2.

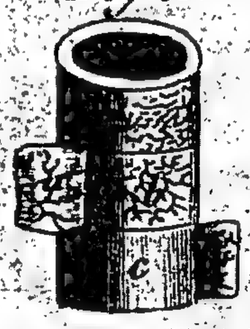


Fig. 3.

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BRAIN.

Fig. 1.

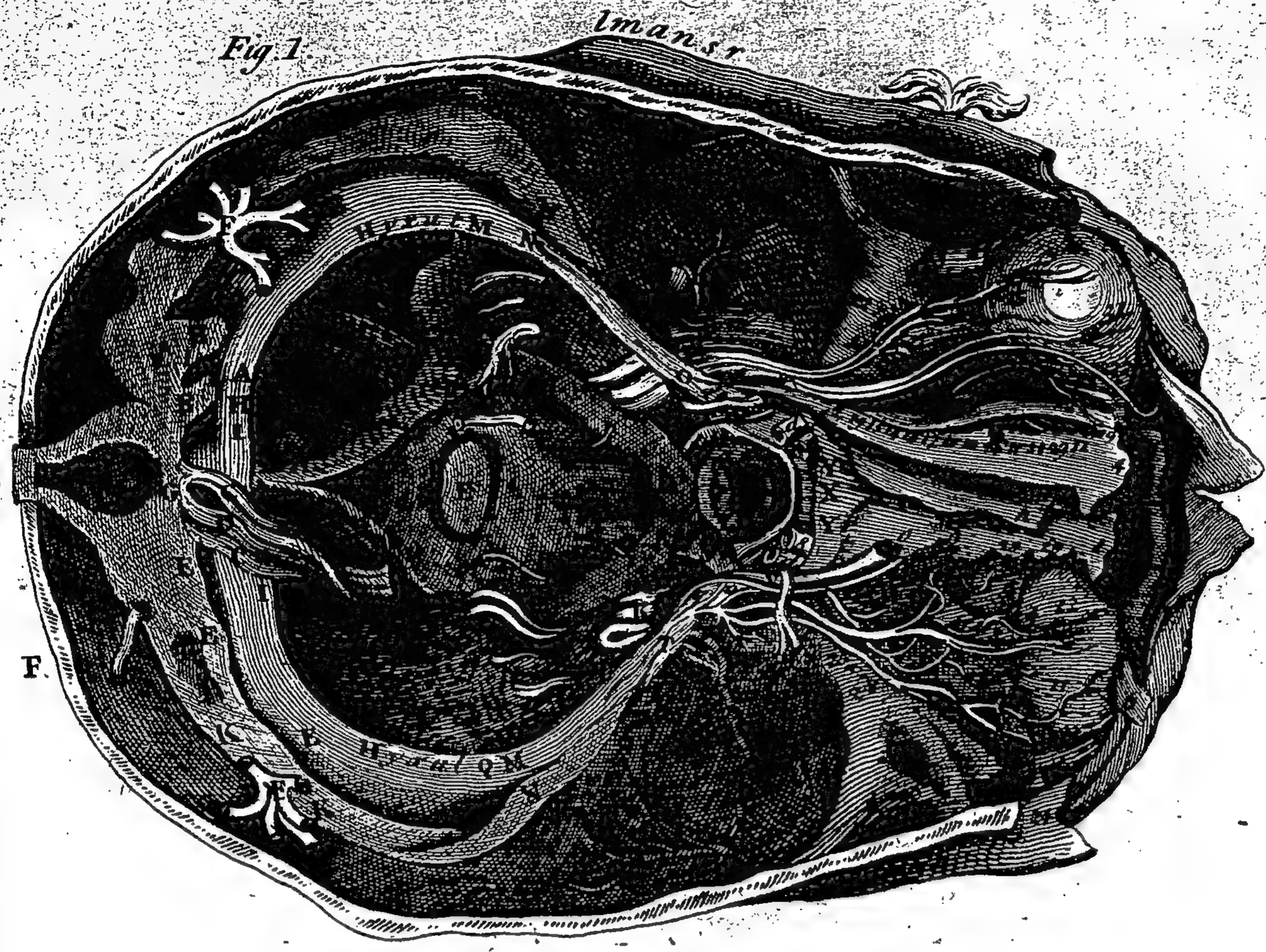
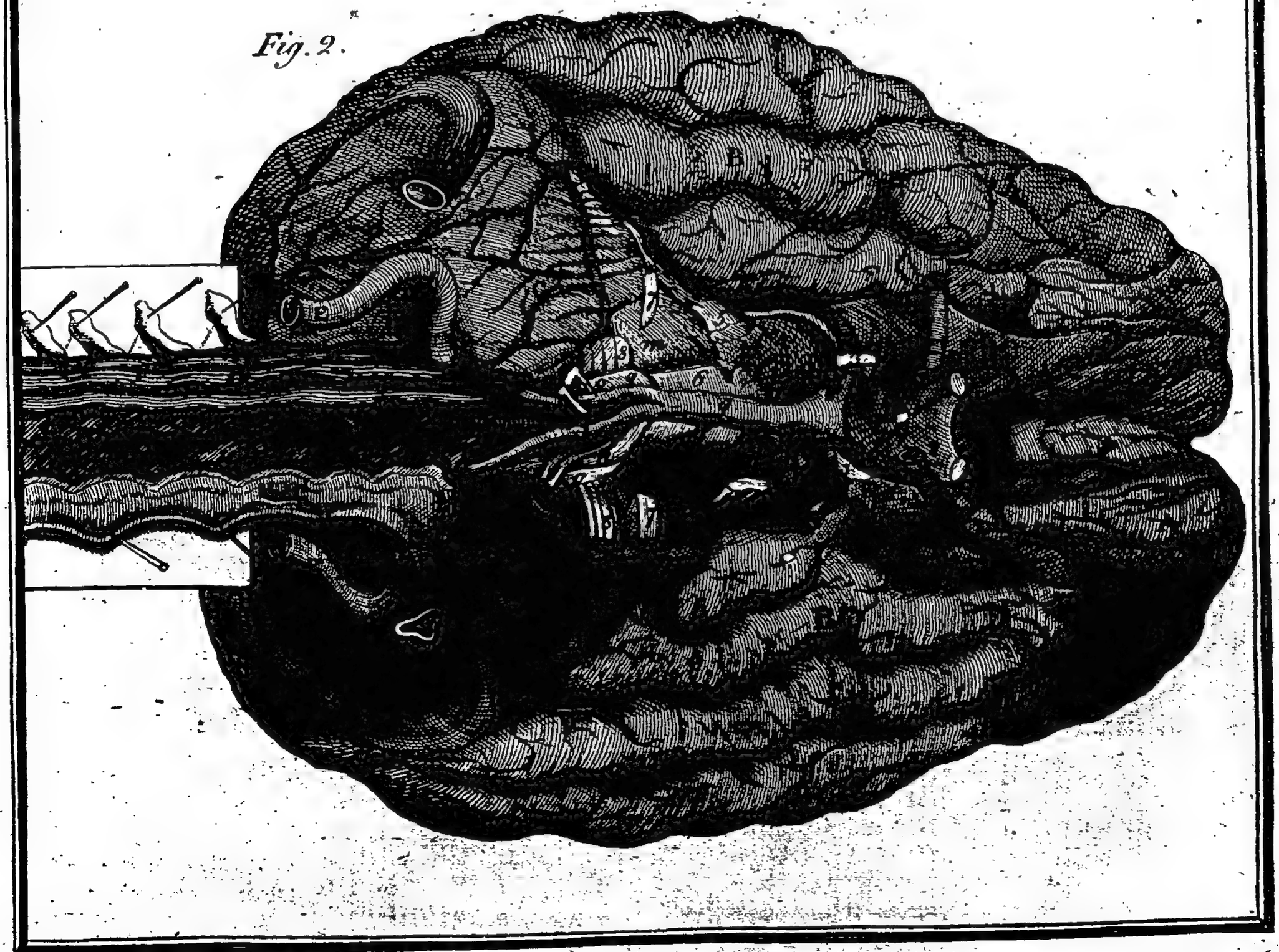


Fig. 2.



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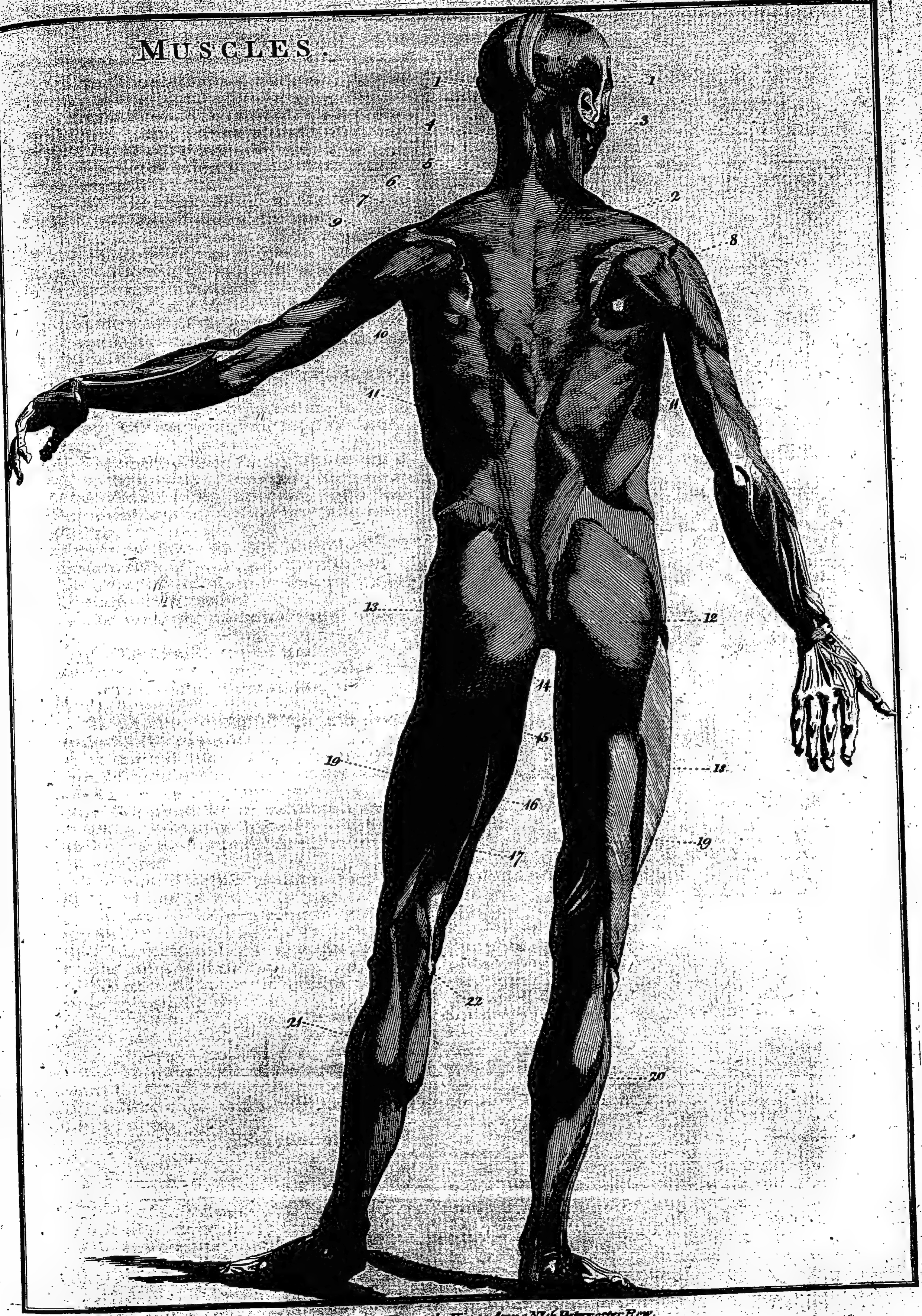
MUSCLES.



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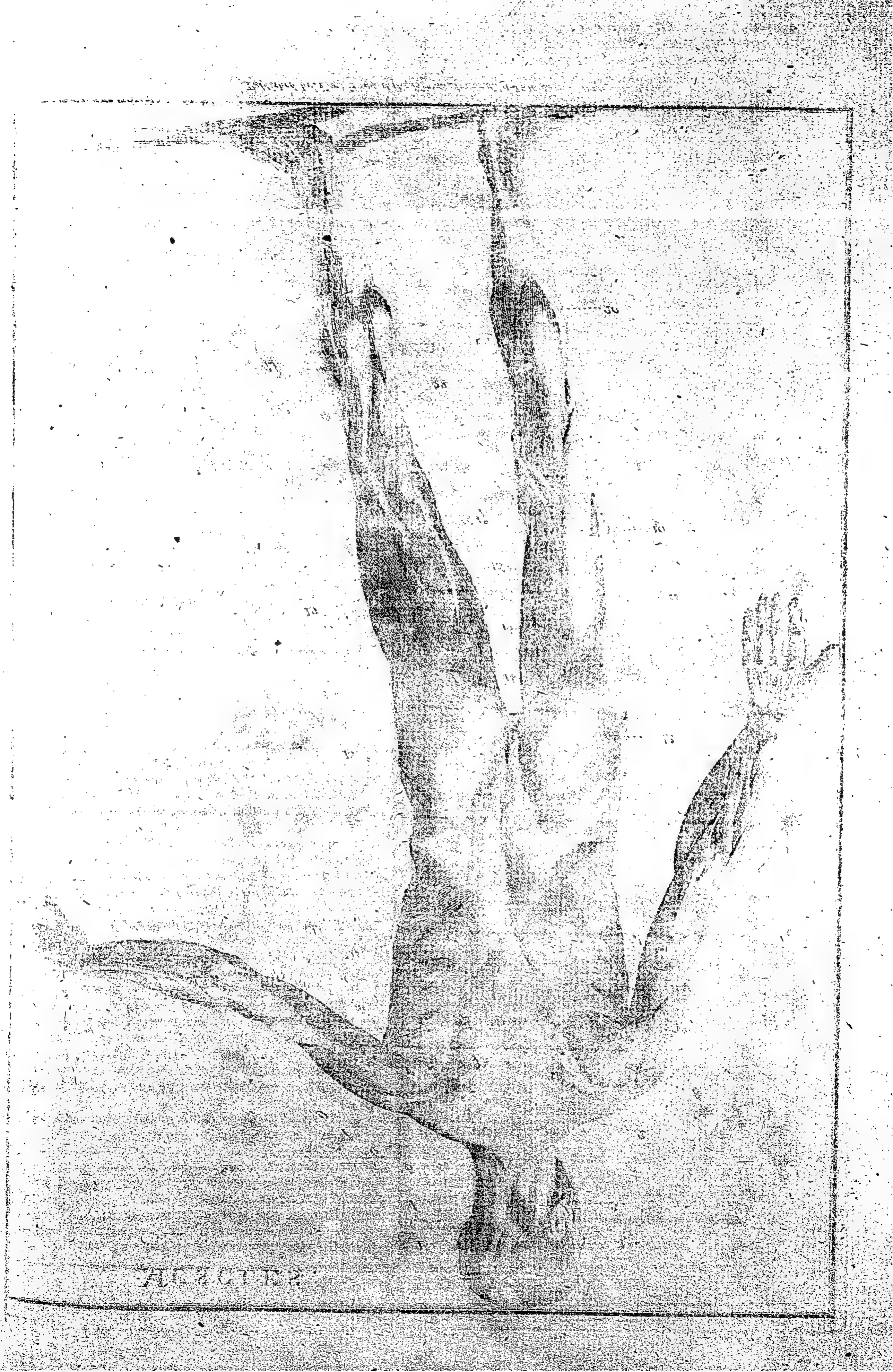


21. 21. The mammariæ, which ariſe from the ſubclavian arteries, and deſcend to the cartilages of the true ribs internally, on each ſide the os pectoris or ſternum. Some branches of theſe paſs through the pectoral as well as intercoſtal muſcles, and give blood to the breaſt, where they meet ſome branches of the intercoſtal arteries.

22. 22. The arteries of the muſcles of the os humeri, and ſome of thoſe of the ſcapula.

23. 23. 24. 24. Thoſe parts of the large trunks of the arteries of the arm, which are liable to be wounded in opening the vena baſilica, or innermoſt of the three veins in the bending of the cubit.

25. 25. A communicant branch of an artery ariſing from the trunk of the artery of the arm, above its flexure at the cubit, which is inoſculated with the arteries below the cubit.

26. 26. The external artery of the cubit, which makes the pulſe near the carpus.

27. 27. Arteries of the hands and fingers.

28. 28. The deſcending trunk of the arteria magna.

29. The bronchial artery, ſpringing from one of the intercoſtal arteries: it ſometimes ariſes immediately from the deſcending trunk of the aorta; and at other times from the ſuperior intercoſtal artery which ſprings from the ſubclavian.

30. A ſmall artery, ſpringing from the fore parts of the aorta deſcendens, and paſſing to the gula.

31. 31. The intercoſtal arteries on each ſide the arteria magna deſcendens.

32. The trunk of the arteria cæliaca, whence ſpring,

33. 33. The hepatick arteries, and

34. The arteria cyſtica, or the gall-bladder.

35. Arteria coronaria ventriculi inferior.

36. The pylorica.

37. The epiploica dextra, ſiniſtra, and media, ſpringing from the coronaria.

38. The rammifications of the coronary artery, which embrace the bottom of the ſtomach.

39. Coronaria ventriculi ſuperior.

40. 40. The phrenick arteries, or the two arteries of the diaphragm; that on the left ſide ariſing from the trunk of the arteria magna; the right ſpringing from the cæliaca.

41. The trunk of the ſplenick artery, ariſing from the cæliaca, contorted.

42. The two ſmall arteries going to the upper part of the duodenum and pancreas; the reſt of the arteries of the pancreas ſpring from the ſplenick artery in its paſſage to the ſpleen.

43. The trunk of the arteria meſenterica ſuperior turned towards the right ſide.

44. The branches of the ſuperior meſenterick artery, freed from the ſmall guts. Here the various anaſtomoſes the branches of this artery make in the meſentery, before they arrive at the inteſtines, may be obſerved.

45. The inferior meſenterick artery, ariſing from the arteria magna.

46. Remarkable anaſtomoſes of the meſenterick artery with the ſuperior.

47. 47. The branches of the inferior meſenterick artery, as they paſs to the inteſtinum colon.

48. Thoſe of the rectum.

49. The emulgent arteries of the kidneys.

50. The vertebral arteries of the loins.

51. 51. The ſpermatick arteries, which deſcend to the teſtes, and are ſo ſmall as to eſcape being filled with wax.

52. Arteria ſacra.

53. Arteriæ iliaci.

54. 54. Rami iliaci externi.

55. 55. Iliaci interni.

56. 56. The two umbilical arteries cut off; that on the right ſide is drawn as in the fœtus, and the left expreſſed as in an adult.

57. 57. The epigraſtick arteries, which aſcend under the right muſcles of the abdomen, and are inoſculated with the mammariæ.

58. 58. Branches of the external iliac arteries, paſſing between the two oblique muſcles of the abdomen.

59. 59. Branches of the internal iliac arteries, which convey the blood to the extenſores and obturatores muſcles of the thighs.

60. The trunks of the arteries which paſs to the penis.

61. 61. The arteries of the bladder.

62. 62. The internal arteries of the pudendum, which, with thoſe here expreſſed with the penis, make the hypogaſtrick arteries in women.

63. The penis extended with wax, and dried.

64. The glans penis.

65. The upper part of the dorſum penis, cut from the body of the penis, and raiſed, to ſhew the corpora cavernoſa penis.

66. Corpora cavernoſa penis, freed from the oſſa pubis, and tied after inflation.

67. The two arteries of the penis, as they appear injected with wax.

68. The capſula and ſeptum of the corpora cavernoſa penis.

69. The crural arteries.

70. 70. The arteries which paſs to the muſcles of the thighs and tibiæ.

71. That part of the crural artery that paſſes the ham.

72. The three large trunks of the arteries of the legs.

73. The arteries of the foot, with their communicating branch, from their ſuperior to their inferior trunk, as well as their communications at the extremity of each toe, like thoſe of the fingers.

Explanation of the Plate of the Brain.

Fig. 1. Is an interior view of the cerebrum and cerebellum.

A, The tranſverſe ſeptum or tent of the cerebellum. B, the longitudinal ſinus of the dura mater, which is divided into two branches at its poſterior extremity. C, the right ſinus divided into two parts, one of which communicates with the right lateral ſinus, and the other with the left. D, veſtiges of the falx of the brain. E, E, the large veins of the ſeptum A. F, the inſertion of the veins of the cerebrum into the lateral ſinus. G, the orifice of the poſterior occipital ſinus. H, H, the poſterior occipital ſinuſes on the right and left. I, I, the falx of the cerebellum. K, K, the great tranſverſe ſinus. L, L, the jugular foſſæ. M, M, the ſinus petroſi inferior. N, N, the ſinus petroſi ſuperior. O, O, the veins of the cerebellum which open into the above ſinuſes. P, P, the inferior occipital ſinuſes. Q, Q, the canal by which they diſcharge themſelves, and which joins the ninth pair. R, R, the anterior and ſuperior occipital ſinuſes. S, S, the communication between the ſinus cavernoſus and circularis. T, the orifice of the ſinus petroſus ſuperior, by which it communicates with the ſinus cavernoſus. V, V, ſinus cavernoſi. X, X, the tranſverſe ſinus of the pituitary foſſa. Y, Y, the circular ſinus of Ridley. Z, Z, the inſertion of the anterior veins of the cerebrum into the ſinus cavernoſi. *a*, *a*, the principal artery of the dura mater. *b*, *b*, the vein which accompanies it. *c*, the part of the cranium which it there enters by a particular foramen. *d*, *d*, the internal carotid arteries in the ſinus cavernoſus cut off at the place where they enter the cerebrum. *e*, *e*, the arterial branches ſent to the ſinus

of the nerve of the fifth pair. *f, f*, part of the internal carotid produced to the ophthalmick artery. *g, g*, the posterior apophyses clinoides. *h*, the apophysis, called crista galli. *i, i*, the frontal sinuses. *k, k*, branches of the fifth pair, distributed on the dura mater. *l*, the fourth branch of the fifth pair. *m*, the second branch. *n*, the first of ophthalmick branch. *o*, the third part. *q*, the partition which divides the fifth and sixth pair. *r*, the sixth pair. *s*, origin of the intercostal nerve. *t, t*, entrance of the seventh pair into the dura mater. *u, u*, first insertions of the eighth pair. *x, x*, second insertions of the eighth pair. *y, y*, the ninth pair. *z*, the foramen of the medulla spinalis.

In the right Eye, the superior Part of the Orbit taken off.

1, 1, The ophthalmick artery. 2, 2, its exterior branch, which accompanies the nerve of the same name. 3, 3, the interior branch distributed to the nostrils. 4, 4, the sclerotick branches, several of which are distributed to the uvea. 5, 5, vestiges of the levator muscles of the eye-lid and of the eye. 6, the extremity of the levator of the eye-lid. 7, the lacrymal gland. 8, the optick nerve. 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, the same as in the eye of the opposite side.

In the left Eye.

9, The annular cartilage. 10, the great oblique muscle. 11, the levator of the eye. 12, the abductor or internal muscle of the eye. 13, the abductor cut off. 14, the superior branch of the third pair, distributed to the eye and eyelid. 15, the other part of the trunk. 16, branch to the nerve to the obliquus inferior. 17, branch to the right inferior of the eye. 18, branch to the right internal. 19, branch to the ophthalmick ganglion. 20, superior branch of the first branch of the fifth pair. 21, the exterior rope of that branch. 22, interior rope. 23, exterior branch of the first branch of the fifth pair. 24, small branches extended to the face, through the foramina of the ossa malarum. 25, branches to the lacrymal gland. 26, inferior branches of the second branch of the fifth pair. 27, rope of that branch to the ganglion. 28, small filaments to the nostrils. 30, the ophthalmick ganglion. 31, the small ciliary nerves. 7, 8, the same as in the right eye.

Fig. 2. Exhibits the basis of the brain, with part of the medulla oblongata, the blood vessels being injected with wax.

A, A, the fore lobes of the brain.

B, B, the hinder lobes.

C, C, the cerebellum.

D, D, the lateral sinuses.

E, E, the vertebral arteries, as they pass between the first vertebra and the bone of the occiput.

F, the vertebral sinus.

G, G, G, G, G, the dura mater on the right side taken off from the spinal marrow, and remaining on the left.

1, 2, 3, 4, &c. the ten pair of nerves belonging to the brain, with seven of the spinal marrow.

a, the foramen that opens into the pituitary gland from the infundibulum.

b, b, the two white protuberances behind the infundibulum.

c, c, the two trunks of the carotid artery, cut off where they began to run betwixt the fore and hinder lobes of the brain.

d, d, the two arteries joining the carotids, with the cervical artery called the communicant branches.

e, e, two large branches of the cervical artery, sometimes seeming as though they came from the communicant branch on each side, from the first of which the plexus choroides hath its original in chief, and from the last the plexus choroides of the fourth ventricle.

f, several little branches arising from the carotid artery.

g, the cervical artery composed of the two trunks of the vertebral artery within the cranium.

h, h, the two trunks of the vertebral artery.

i, i, i, the spinal artery.

k, a small branch of an artery running through the ninth pair.

l, l, the crura of the medulla oblongata.

m, m, the annular protuberance, or pons varolii.

n, that part of the caudex medullaris on the right side, called, by Willis and Vieussenius, corpora pyramidalia.

o, that part on the same side called corpus olivare.

p, the foremost branch of the carotid artery, dividing the fore lobes of the brain, consisting of two branches, one of them only appearing here.

q, q, little branches of arteries helping to make the plexus choroides in the fourth ventricle.

r, r, r, r, branches of arteries dispersed from the cervical artery upon and through the annular protuberance.

s, s, part of the second process or pedunculi of the cerebellum.

t, t, the spinal accessory nerve.

Illuſtration of the BOTANICAL PLATES.

IN our INTRODUCTION to the Natural Hiſtory of VEGETABLES, page 296, we obſerved, that the immenſe labours, which ſome late botaniſts have undergone, to give a liſt of the names of plants, can contribute little to the diſcovery of their properties. We ſhould be led to ſuppoſe, from the repeated endeavours to ſyſtematiſe this ſcience, that the whole of the ſtudent's purſuit was directed to acquire the names of plants. More time has been conſumed in making catalogues of this nature, than, if properly applied, would have been ſufficient to have enabled the botaniſt to diſcover ſeveral new properties in the vegetable world, as yet unknown.

For theſe reaſons, the botanical ſyſtems of flowers, plants, leaves, moſſes, and cups of flowers, were, intentionally, omitted: however, in order to gratify the taſte of curious ſpeculators, and that of the learned, we ſhall here treat the above ſubjects agreeable to ſyſtematical arrangements; particularly thoſe adopted by LYNNÆUS and TOURNEFORT; wherein the ſeveral Orders and Genera of flowers and plants will be conſidered; and for a particular account of the various characters, and Latin appellations, we refer our readers to the numerous plates, under the general head of Botany.

BOTANY.

THE term Botany, ſays a modern writer, has been underſtood as expreſſing the doctrine of plants at large, and in all its various lights; but tracing the origin and progreſs of the ſtudy, we ſee it at ſeveral periods under diſtinct appearances. Theſe, however, are all reducible to thoſe general heads, which we may diſtinguiſh by the terms philoſophic, hiſtorical, and ſyſtematic Botany. Of theſe the firſt and nobleſt has been the leaſt cultivated; it began, and in a manner ended, with Theophraſtus; its object is the nature of vegetables as vegetables, independent of all other conſiderations; to this ſucceeded the hiſtorical branch, gathering the names and numbers of plants, their places of growth, their virtues, and other œconomic uſes: this was the object of thoſe, who ſtudied herbs, from Theophraſtus to the latter end of the ſixteenth century; when Cæſalpinus gave origin to the ſyſtematic Botany: till this time plants were arranged, even thoſe who wrote beſt on them, according to the old and irregular diviſion, into trees, ſhrubs, and herbs; or according to their virtues, the letters of the alphabet, which began with their names, or by ſuch vague and arbitrary methods. Their increaſed number now made it neceſſary they ſhould be better arranged: and this great author has ſtruck out that path, which has ſince been trod ſo happily, of examining their parts and deducing thence the characters of claſſes, arranging in each claſs all thoſe, which had the peculiar mark which made its diſtinction. The origin of ſyſtematical diſtribution was the ſelecting ſome part of a plant, which was obvious and regular in itſelf, and eſtabliſhing a character upon its deſcription, to which all others that had the ſame mark were referred. Thus were formed the characters of claſſes firſt, and then the diſtinctive mark of the genera. Between theſe there came naturally ſome leſſer peculiarity, the ſubdiviſion of the claſſes by orders. The original invention was the choice of ſome one part of the character, and what part that ſhould be was left to diſcretion. The great inventor choſe the ſeeds, which he arranged according to the ſituation of the corculum, or heart of the ſeed, and to its place upon the plant; and upon this baſis he founded the firſt arrangement of plants. Afterwards various parts of plants, and various collections of parts were adopted for the characters of claſſes. One hundred and three years after Cæſalpinus, Morriſon a Briton, entered ſucceſsfully into the ſame path; Ray followed, Knoutius followed Ray, and Herman followed him. Riverius was cotemporary with Knoutius; theſe both wrote in the year 1690, and after four years more followed Tournefort, the greateſt of them all. Thus cloſed upon the ſcience the ſeventeenth century, in the laſt ſeventeen years of which the long neglected inſtitution of Cæſalpinus was ſo well revived, that there appeared no leſs than ſix diſtinct ſyſtems of plants, and each of very conſiderable merit. The authors of the four firſt held the fruits and ſeed, according to the original practice of Cæſalpinus, to be the propereſt, at leaſt the moſt eſſential parts, on which to found a ſyſtem. Riverius ſtruck out the deſign of fixing the characters in the flower, and Tournefort purſued this with the greateſt attention, induſtry and truth: Boerhaave, who wrote in the beginning of the 18th century, continued the ſyſtem in its original courſe, making the fruits and ſeeds of plants his great object in their arrangement. In 1711, Hencher of Wirtenberg appeared with credit, and led a long train; who leſs regarding the original object of diſtinction, followed Riverius and Tournefort in the choice of the flower. Seven years after, Ruppius wrote, adopting the ſame part as the foundation of his ſyſtem, and thus continued the eſtabliſhed doctrine with Pontedera, Hebenſtret, and Hudwig. In the mean time Magnal diſtinguiſhed himſelf by a new ſyſtem, formed upon the conſtruction of the cup; and in the year 1735 Linnæus, too great for praiſe, publiſhed that ſyſtem of Botany, which characterizes the claſſes according to the parts of generation or fructification, the filaments, and ſtyle; and takes into the general diſtinction all the flower.

FLOWERS.

THOUGH no part of plants is more different than their flowers, yet the definitions given by different authors of the word are extremely various, and are very neceſſary to be explained, in order to the underſtanding their works. Jungius defines it to be the moſt tender part of a plant, remarkable for its colour or form, or for both, and cohering with the fruit. Yet this author himſelf acknowledges his defimtion to be too confined, as he very well knew there were ſeveral plants, whoſe flowers were produced remote from the fruit.

Mr. Ray ſays, the flower coheres for the moſt part with the rudiments of the fruit, but ſuch phraſeology is by no means to be admitted into

definitions. Tournefort defines it to be a part of a plant very often remarkable for its peculiar colours, for the moſt part adhering to the young fruit, to which it ſeems to afford the firſt nouriſhment, in order to explicate its moſt tender parts; but this is a more indeterminate definition than the former, from its looſe mode of expreſſion. Pontedera defines it to be a part of a plant, unlike the reſt in form and nature. If the flower has a tube, it adheres to, or is fixed very near to the embryo, to the uſe of which it is ſubſervient; but if the flower has no tube, then its baſe does not adhere to the embryo. This is ſcarce intelligible except to the expert botaniſt, and may be made to take in ſome parts of plants by no means to be underſtood by the name of flowers. Juſſieu defines it to be compoſed of chives and a piſtillum, and to be of uſe in the generation of the plant: but this is too imperfect, as there are many plants in which the piſtillum is found at a great diſtance from the chives, and many flowers which have no piſtillum, and many others which have no chives.

Valliant, however, has been happier in his definition; he ſays, that flowers are the organs which conſtitute the different ſexes of plants, which are ſometimes found naked and without any covering; and that the petals, which moſt of them have, are no way eſſential to their uſe, but ſerve and are intended merely as covers for them; but as theſe coats or coverings are the moſt conſpicuous, and moſt beautiful part of the flower, theſe are to be called flowers, be they of whatever form or ſtructure, or colour; and whether they contain only the organs of both ſexes in each individual, or only of one, or even but of ſome part of one, provided that they are not of the ſame figure and colour with the leaves of the plant. The ſhorteſt and moſt expreſs definition, however, ſeems to be Martyn's; which is, that flowers are the organs of generation of both ſexes, adhering to a common placenta, together with their common covering, or of either ſex ſeparately with its proper coverings, if it have any. The ſtructure of the different flowers are very various; but Dr. Grew has obſerved, that the far greater number of them have the impalement, the foliation, and the attire of chives, &c. Mr. Ray accounts that every perfect flower has the petals, ſtamina or chives, apices or ſummits, and the ſtyle or piſtil, and ſuch as want any of theſe patts he calls imperfect flowers. The greater number of plants have a flower-cup which is of a firmer ſtructure than their leaves, and ſerves for their ſupport. The parts of a flower are the ovary or piſtil, the corolla or flower-petals, the ſtamina or chives, the impalement or calyx, and the perianthium, pericarpium, and fruit.

Explanation of the Terms uſed in BOTANY.

PISTIL, *Piſtillum*, denotes the female organ of generation in flowers, and is defined, by Linnæus, as an entrail of the plant, deſigned for the reception of the farina, or male-duſt, wherewith it becomes impregnated; it conſiſts of three parts, viz. the germen, ſtyle, and ſtigma; the germen is the rudiment of the fruit, accompanying the flower, and is of various ſhapes, but always ſituated below the ſtyle, or ſtigma, and contains the embryo ſeeds; the ſtyle is the part that ſerves to elevate the ſtigma from the germen, and is alſo of different forms; the ſtigma, which is of various ſhapes likewiſe, is always placed on the top of the ſtyle, or, if that be wanting, on the top of the germen; this part is covered with a moiſture, for the breaking of the farina into more minute parts.

COROLLA is the moſt conſpicuous part of a flower. It expreſſes the coloured tender part, which ſurrounds the organs of generation. The part it is compoſed of are called petals; if it conſiſts only of one piece, it is called monopetalous: if c more, it is ſaid to be dipetalous, tripetalous; and ſo on, as it conſiſts of two, three, four, or more parts.

STAMINA, the male parts of a flower, or its male organs of generation. Linnæus defines the ſtamina the entrail of the plant, deſigned for the preparation of the pollen.

Each ſtamen conſiſts of two parts. 1. The filament or thread, which ſerves to elevate the anthera or ſummit, and at the ſame time connects it with the flower. 2. The anthera, or ſummit itſelf, which contains within it the pollen, and when come to maturity, diſcharges the ſame.

The ſtamina being the male part of the flower, the conſtruction and diſtribution of the ſexual ſyſtem, is principally founded upon, and regulated by them. Such flowers as want the ſtamina, are called female flowers: ſuch as have the ſtamina, but want the piſtillum, or female part, male flowers; ſuch as have them both, hermaphrodite flowers; and ſuch as have neither, neuter flowers.

Mr. Tournefort takes the uſe of the ſtamina to be, as it were, ſo many excretory canals for diſcharging the growing embryo of its redundant juices; and of theſe excrements of the fruit, he takes that farina, or duſt, found in the apices, to be formed. But other writers, as Geoffroy, and Linnæus in particular, aſſign the ſtamina a nobler uſe: theſe authors, explaining the generation of plants in a manner analogous to that of animals, maintain the uſe of the ſtamina to be that of ſecreting, in their fine capillary canals, a juice, which being collected, hardened, and formed into a farina, or duſt, in the tops of the apices, is thence, when the plant arrives at maturity, diſcharged by the burſting of the apices upon the top of the piſtil, whence is a paſſage for it to deſcend into the uterus, where being received, it impregnates and fecundifies the plant.

CALYX, or Impalement, among botaniſts a general term, expreſſing the cup of flowers, or that part of a plant which ſurrounds, incloſes, or ſupports the other parts of the flower. The cups of flowers are very various in their ſtructure, and are diſtinguiſhed by the names of perianthium, involucrum, ſpatha and gluma. Botaniſts diſtinguiſh two ſorts of Calices, one external, called the Calyx of the flower: by the antients perianthium, as encompaſſing the flower and ſeed; the other internal, called the Calyx of the fruit: by the antients pericarpium, as being the capſule which compaſſes the fruit, and is itſelf encompaſſed by the petala. The external Calyx may alſo be divided into two ſorts, one which ſurrounds the flower, another which ſuſtains it, different from the pedicle; as the latter ſpreads itſelf underneath the flower, to give room for the nutritious juice to raiſe more freely; the cavity of the pedicle enlarged, is reputed part of the Calyx both external and internal.

PERIANTHIUM, a flower-cup ſituated cloſe to the fructification. It ſurrounds the lower part of the flower, and conſiſts of ſeveral leaves, or of one leaf divided into ſeveral ſegments. If it includes the ſtamina and not the germen, it is the Perianthium of the flower; if the germen but not the ſtamina, the Perianthium of the fruit: but if it includes both, it is the Perianthium of the fructification.

PERICARPIUM, a covering or caſe for the ſeeds of plants; it is the germen of the piſtil enlarged: there are no leſs than nine ſpecies of pericarpia. 1. A Capſule. 2. A Conceptaculum. 3. A Pod. 4. A Ligumen. 5. A Nut. 6. A Drupe. 7. An Apple. 8. A Berry. 9. A Strobilus.

THE

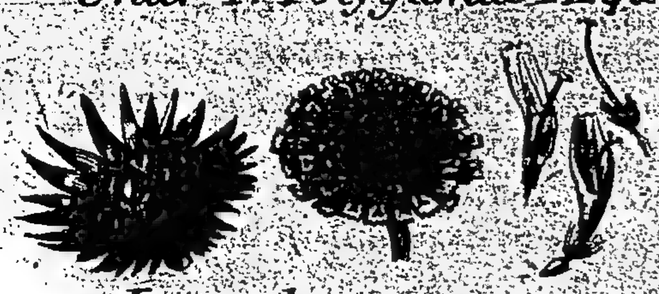
Linnean System.

ORDERS of FLOWERS.

Class XIX. Syngenesia. The Stamens & Antheræ grown together in form of a Cylinder.

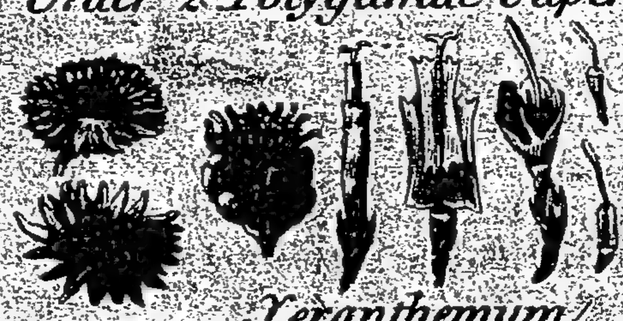
(having rarely Filaments.)

Order 1. Polygamia Æqualis



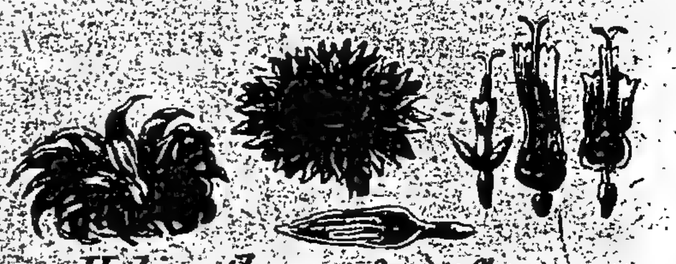
Leontodon, Dandelion.

Order 2. Polygamia Superflua.



Xeranthemum

Order 3. Polygamia Frustanea.



Helianthus, Sun-flower.

Order 4. Polygamia Necessaria.

Calendula, Marygold.

Order 5. Polygamia Segregata.

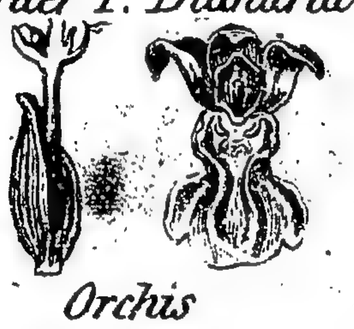
Echinops, Globe Thistle.

Order 6. Monogamia.

Lobelia, Cardinal Flower.

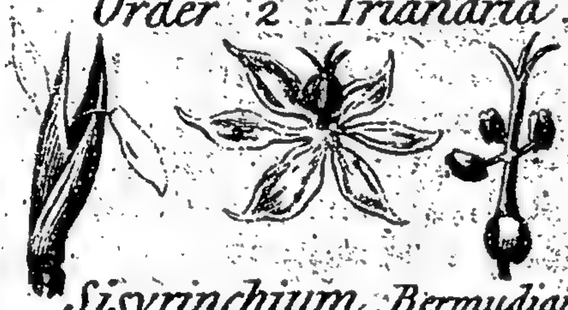
Class XX. Gynandria. The Stamens inserted on the Pistil (not on the Receptacle).

Order 1. Diandria



Orchis

Order 2. Triandria.



Sisyrinchium, Bermudiana.

Order 4. Pentandria.

Passiflora, Passion Flower.

Order 5. Hexandria.

Aristolochia, Birthwort.

Order 7. Polyandria.

Arum, Cuckow Pint.

Class XXI. Monoecia. Male & Female Flowers on the same Plant.

Order 1. Monandria.

Zanichellia, Triple-headed Pondweed.

Order 3. Triandria.

Tripsacum

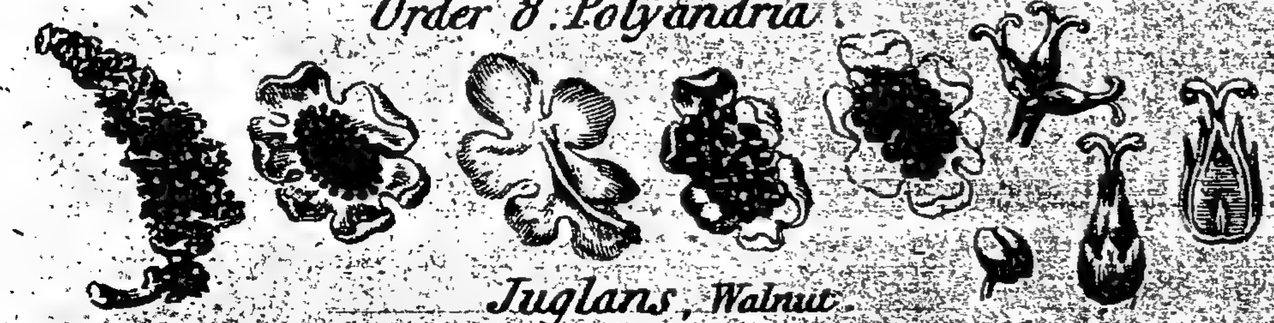
Order 4. Tetrandria.

Urtica, Roman Nettle.

Order 5. Pentandria.

Parthenium

Order 8. Polyandria.



Juglans, Walnut.

Order 9. Monadelphia.

Pinus, Scotch Fir.

Order 10. Syngenesia.

Momordica, Male Balsam Apple.

Order 11. Gynandria.

Andrachne, Bastard Orpine.

London, Published by Alex.r Hogg, at the Kings Arms, N.o 16, Paternoster Row.

I.G. Wooding sculp.

Linnean System.

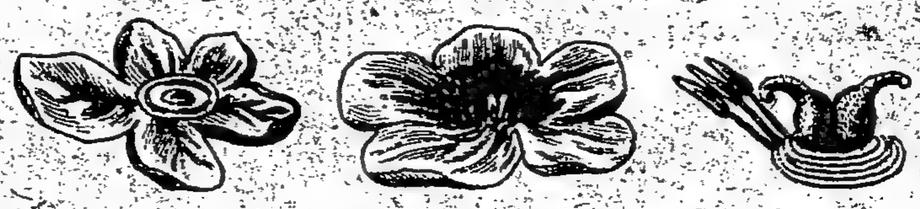
ORDERS of FLOWERS

Class XIII. Polyandria. The Stamens from Twenty to a Hundred in the same Pistil with the Flower

Order 1. Monogynia

Sarracenia

Order 2. Dygynia



Pæonia, Piony.

Order 3. Trigynia

Aconitum, Wolfsbane.

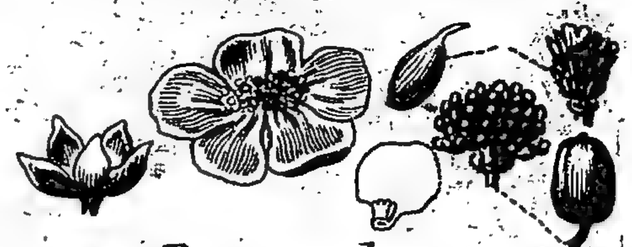
Order 5. Pentagynia

Aquilegia, Columbine.

Order 6. Hexagynia.

Stratiotes, Water Aloe.

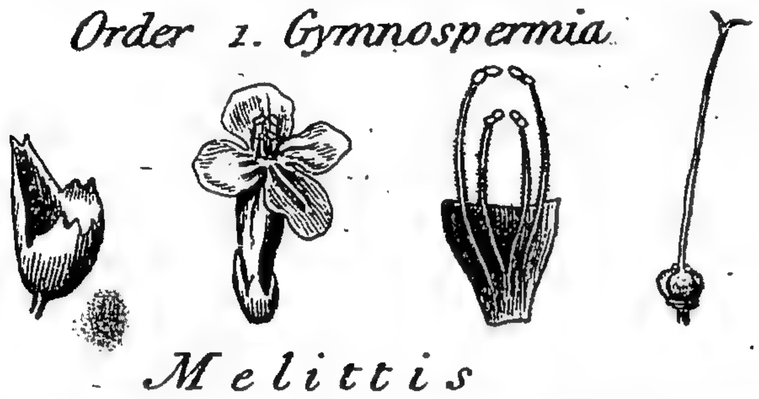
Order 7. Polygynia.



Ranunculus, Crowfoot.

Class XIV. Didynamia. Four Stamens, two are close together and longer

Order 1. Gymnospermia



Melittis

Order 2. Angiospermia

Melianthus, Honey flower.

Class XV. Tetradynamia. Six Stamens, four long, the two opposite short.

Order 1. Siliculosa

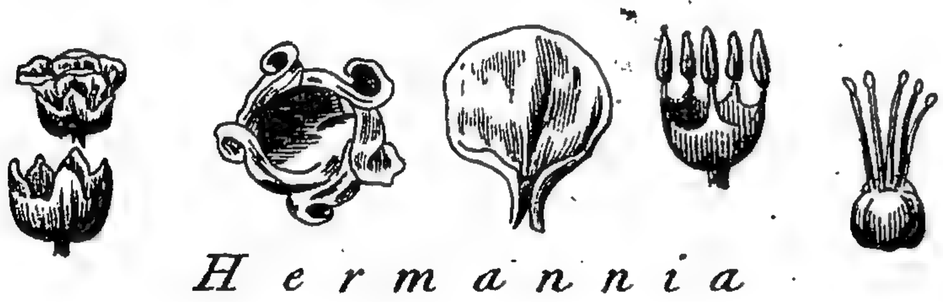
Lunaria, Honesty.

Order 2. Siliquosa

Cheiranthus, Stock July flower.

Class XVI. Monadelphia. The Filaments of the Stamens grown together into one Body.

Order 1. Pentandria



Hermannia

Order 2. Decandria.

Geraniüm, African Cranes-bill.

Order 4. Dodecandria

Pentapetes, Indian vervain Mallow.

Order 5. Polyandria

Alcea, Rose-Mallow.

Class XVII. Diadelphia. The Filaments of the Stamens grown together into two Bodies.

Order 2. Hexandria.

Fumaria, yellow Fumitory

Order 3. Octandria.

Polygala, Milkwort.

Order 4. Decandria.

Lathyrus, everlasting Pea.

Class XVIII. Polyadelphia. The Filaments of the Stamens grown together into 3 or more Bodies.

Order 1. Pentandria

Theobroma.

Order 2. Icosandria

Citrus, Orange.

Order 3. Polyandria

Hypericum, St. John's-wort.

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Lowry sculp.

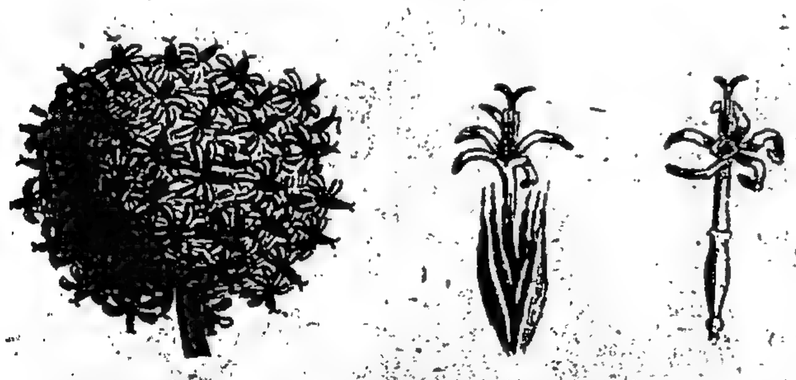
Linnean System.

MONOGYNIA DIGYNIA TRIGYNIA TETRAGYNIA PENTAGYNIA HEXAGYNIA

HEPTAGYNIA DECAGYNIA DODECAGYNIA POLYGYNIA GYMNOSPERMIA

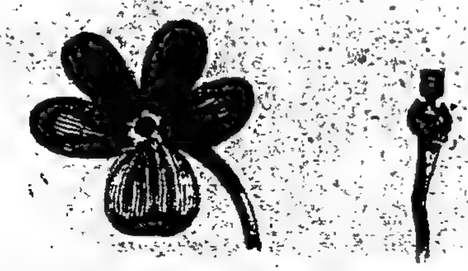
ANGIOSPERMIA SILICULOSA SILIQUOSA POLYGAMIA ÆQUALIS

POLYGAMIA SUPERFLUA POLYGAMIA FRUSTRANEA POLYGAMIA NECESSARIA



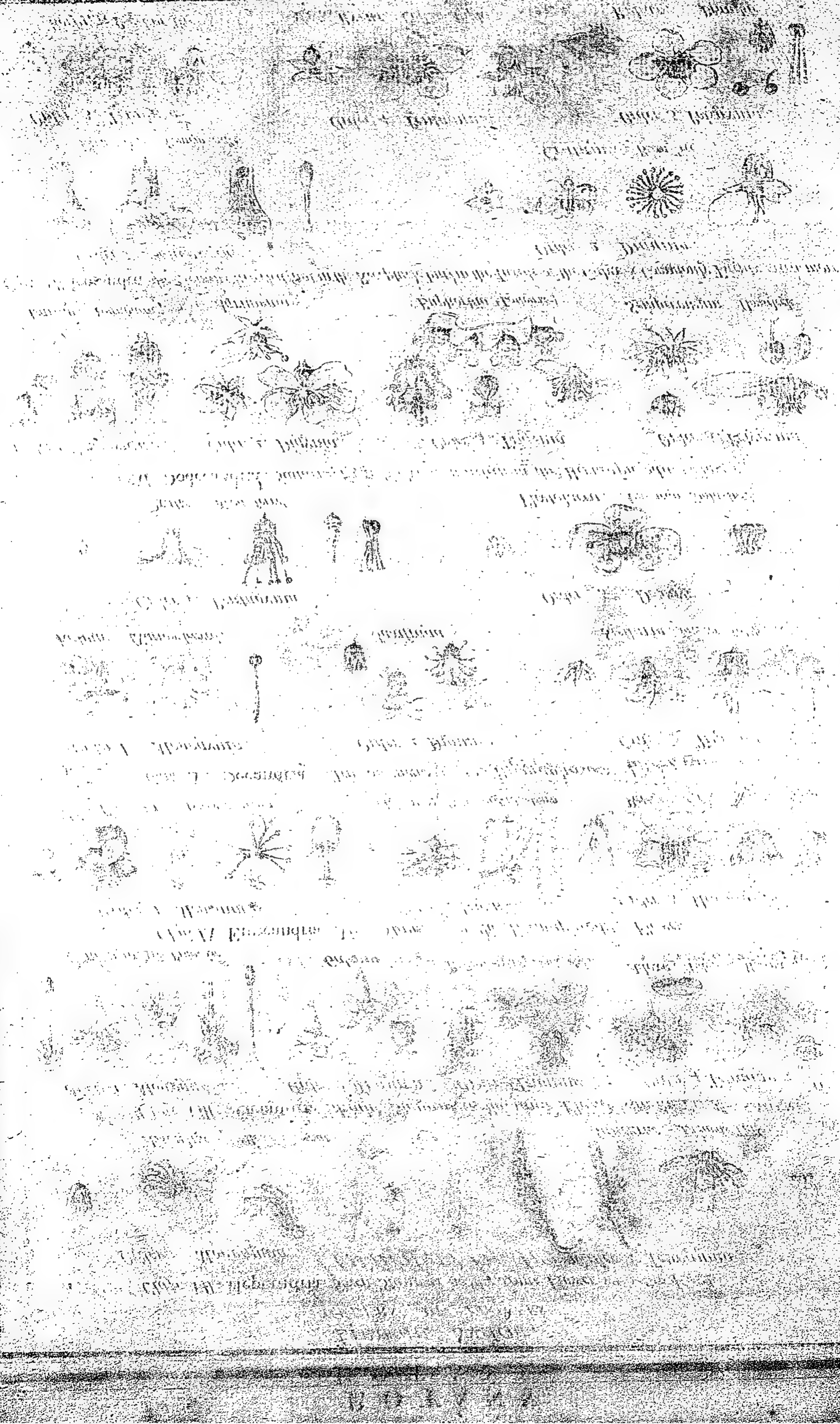
POLYGAMIA SEGREGATA

TRIOECIA



POLYGAMIA MONOGAMIA

FILICES MUSCI ALGÆ FUNGI

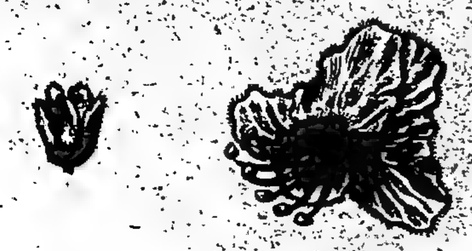


Linnean System.

ORDERS OF FLOWERS.

Clafs VII. **Heptandria.** *Seven Stamens on the same Flower with the Pistil.*

Order 1. Monogynia.



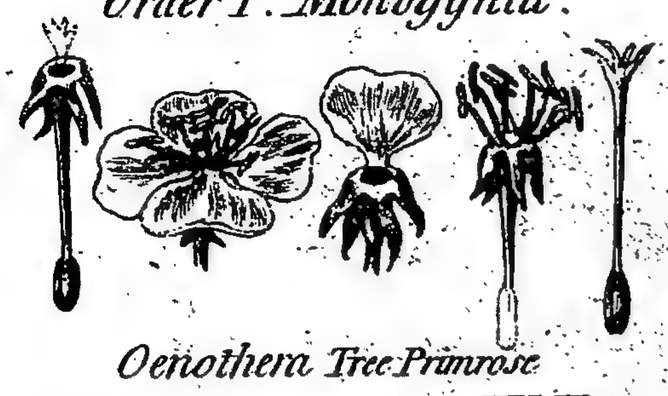
Æsculus *Horse Chesnut*

Order 3. Tetragynia.

Saururus, Lizards Tail

Clafs VIII. **Octandria.** *Eight Stamens in the same Flower with the Pistil.*

Order 1. Monogynia.



Oenothera Tree Primrose

Order 2. Digynia.

Galenia

Order 3 Trigynia.

Polygonum, Buck-wheat

Order 4. Tetragynia.

Adoxa, Tuberous Moschatel

Clafs IX. **Enneandria.** *Nine Stamens in the Hermaphrodite Flower.*

Order 1. Monogynia.

Cafsyta (Berry-bearing

Order 2 Trigynia

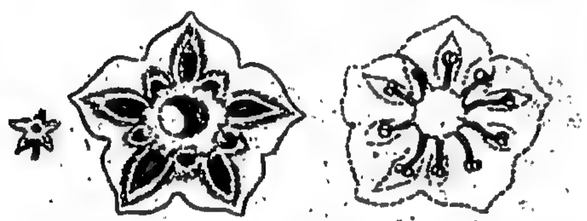
Rheum, Palmated Rhubarb

Order 3. Hexagynia

Butomus, Flowering Rush

Clafs X. **Decandria.** *Ten Stamens in the Hermaphrodite Flower.*

Order I. Monogynia.



Kalmia, (Narrow leaved)

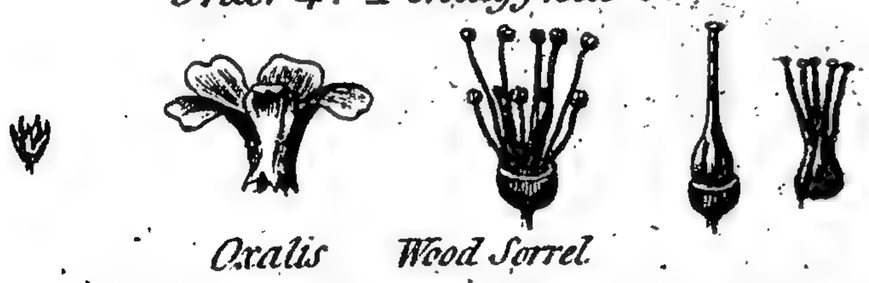
Order 2. Digynia

Saxifraga

Order 3. Trigynia.

Stellaria, Greater Stitchwort

Order 4. Pentagynia.



Oxalis *Wood Sorrel*

Order 5. Decagynia.

Phytolacca, American Nightshade

Clafs XI. **Dodecandria.** *Stamens from twelve to nineteen in the Hermaphrodite Flower.*

Order 1 Monogynia.

Asarum, Asarabacca

Order 2. Digynia.

Agrimonia

Order 3. Trigynia.

Euphorbia, (Lathyris)

Order 5. Polygynia.

Sempervivum Houseleek

Clafs XII. **Icosandra.** *the Stamens inserted (not in the Receptacle but) in the Inside of the Calyx & Commonly Twenty often more.*

Order 1. Monogynia

Punica, Pomegranate

Order 2. Digynia.

Cratægus, Bean Tree

Order 3. Trigynia

Sorbus, Quicken-Tree

Order 4. Pentagynia

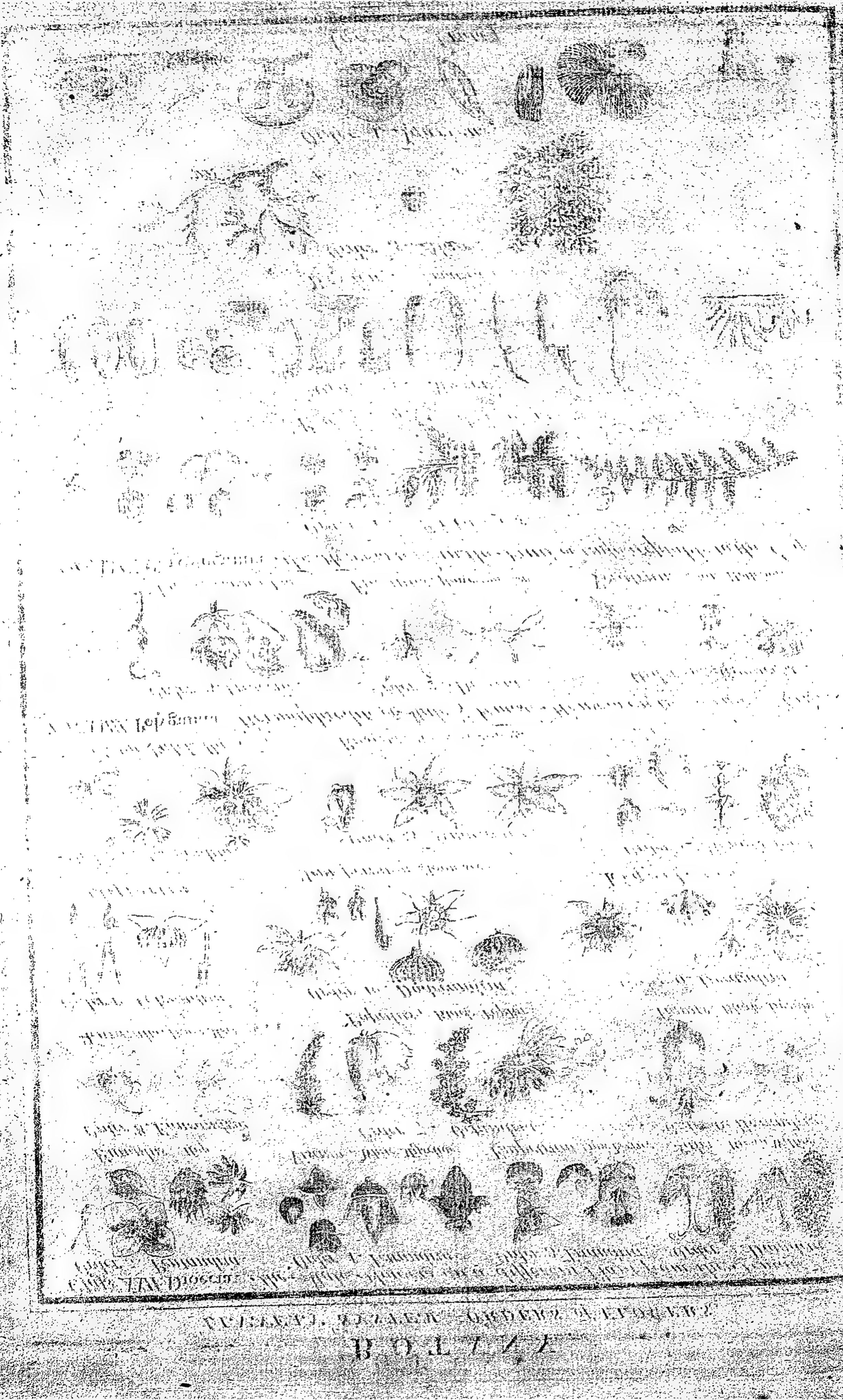
Pyrus, Codlin Apple

Order 5. Polygynia.

Rubus, Bramble

Hatchett sc.

Published by Alex. Hogg, at the Kings Arms Pater-noster Row.



BOTANY.

LINNEAN SYSTEM—ORDERS of FLOWERS.

Clafs XXII. **Dioecia.** *The Male Flowers on a different Plant from the Female.*

Order 5. Pentandria. *Order 4. Tetrandria.* *Order 3. Triandria.* *Order 2. Diandria.*

Humulus, Hop. *Viſcum, White Miſſeltoe* *Empetrum, Crow-berries* *Salix, Brown Willow.*

Order 8. Enneandria. *Order 7. Octandria.* *Order 6. Hexandria.*

Mercurialis, Dogs Mercury. *Populus, Black Poplar.* *Tamus, Black Bryony.*

Order 11. Polyandria. *Order 10. Dodecandria.* *Order 9. Decandria.*

Cliffortia. *Menispermum, Moon seed.* *Kiggelaria.*

Order 14. Gynandria. *Order 13. Syngenesia.* *Order 12. Monadelphia.*

Clutia Pulchella. *Ruscus, Butchers Broom.* *Juniperus, Juniper.*

Clafs XXIII. **Polygamia.** *Hermaphrodite, or Male & Female Flowers on the ſame Plant.*

Order 3. Trioecia. *Order 2. Dioecia.* *Order 1. Monoecia.*

Ficus, common Fig. *Fraxinus, flowering Ash.* *Veratrum, white Hellebore.*

Clafs XXIV. **Chryptogamia.** *The Flowers within the Fruit or imperceptable to the Eye.*

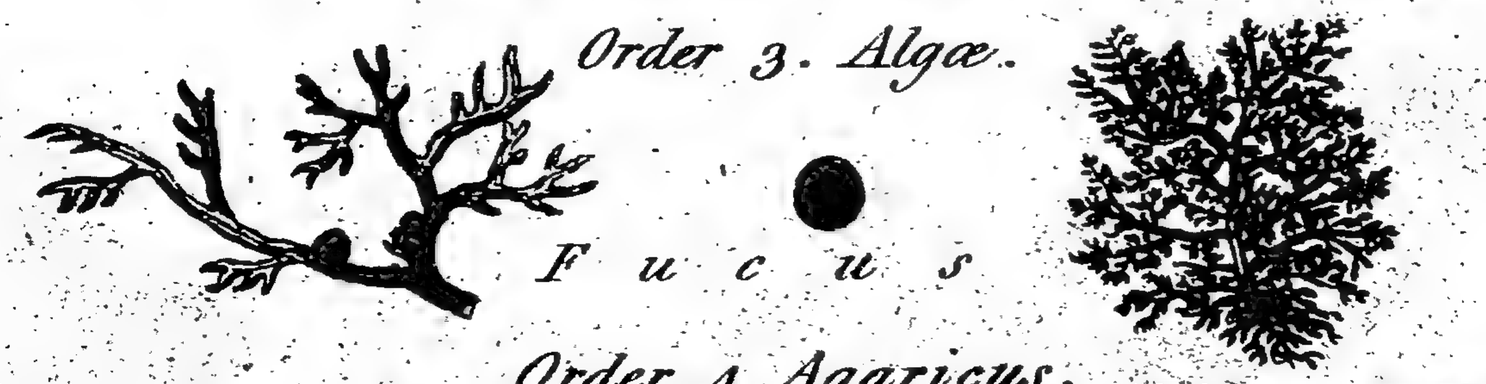
Order 1. Filices.

Polypodium

Order 2. Musci.

Bryum. (matted)

Order 3. Algæ.



Fucus

Order 4. Agaricus.

Agaric (Field)

Sparrow sculp.

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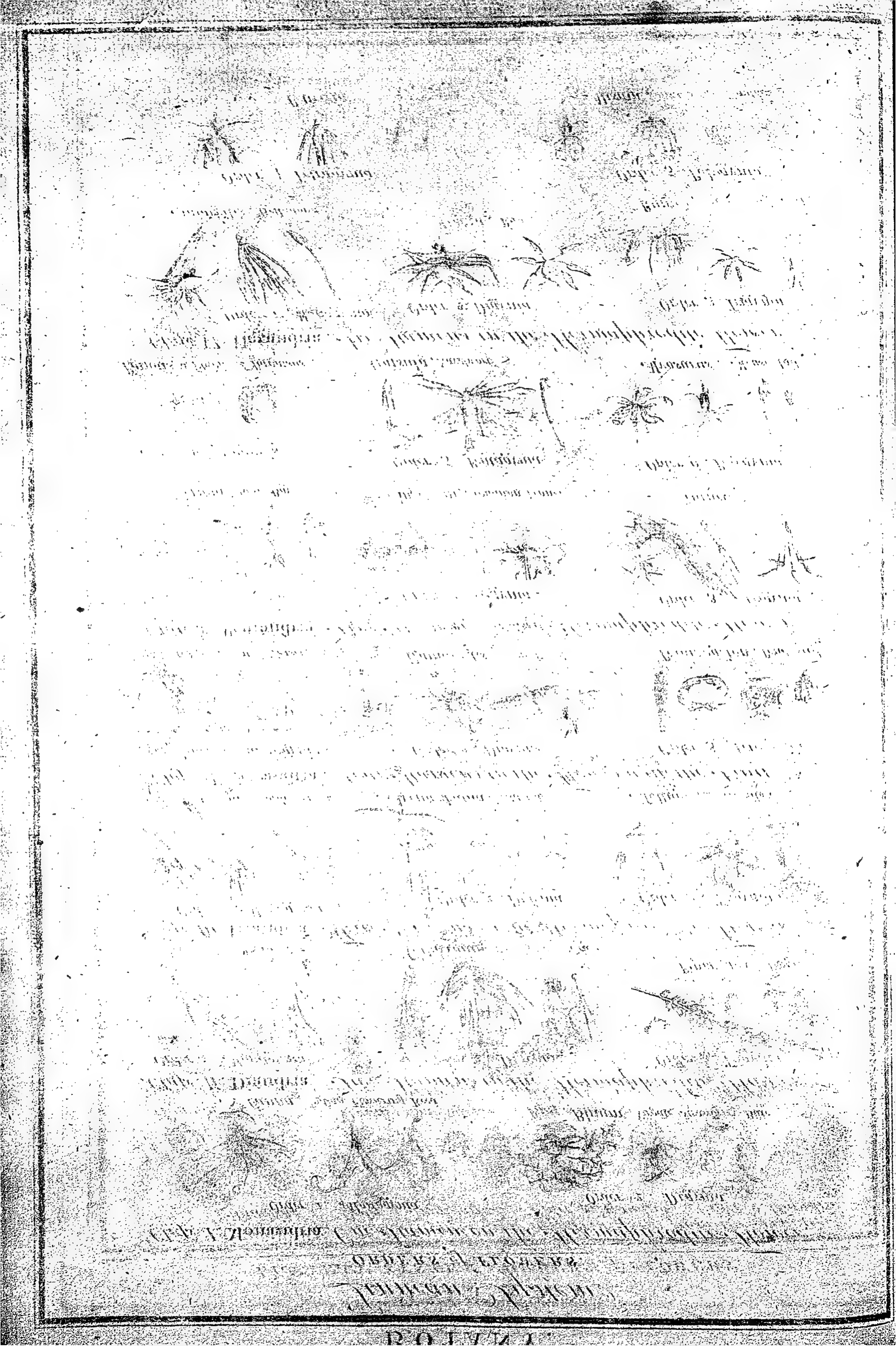


Linnean System

ORDERS of FLOWERS.

Class I. Monandria. One Stamen on the Hermaphrodite Flower

Order 1. Monogynia

Canna, Indian Flowering Reed

Order 2. Digynia

Blitum, Virgate Strawberry Blite

Class II. Diandria. Two Stamens in the Hermaphrodite Flower

Order 1. Monogynia

Monarda, Oswego Tea

Order 2. Digynia

Anthoxanthum, Vernal Grass

Order 3. Trigynia

Piper, Black Pepper

Class III. Triandria. Three Stamens in the Hermaphrodite Flower

Order 1. Monogynia

Crocus, Garden Crocus.

Order 2. Digynia

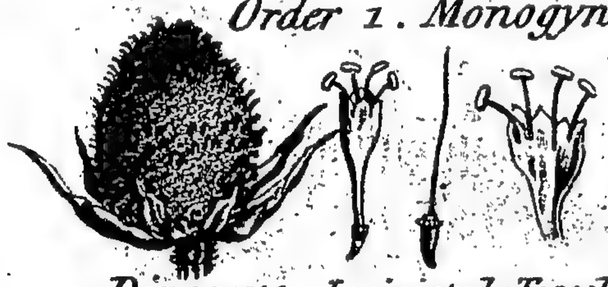
Avena Fatua, Wild Oat.

Order 3. Trigynia

Mollugo, (verticillate)

Class IV. Tetrandria. Four Stamens in the Flower with the Fruit

Order 1. Monogynia



Dipsacus, Laciniated Teasel

Order 2. Digynia

Hamamelis, witch Hazel

Order 3. Tetragynia

Potamogeton, Pond weed.

Class V. Pentandria. Five Stamens in the Hermaphrodite Flower

Order 1. Monogynia

Nerium, Rose Bay.

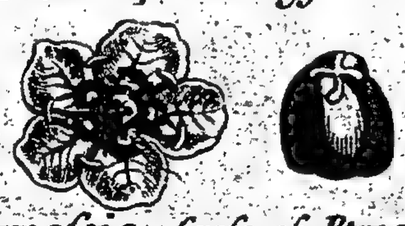
Order 2. Digynia

Anethum, Common Fennel

Order 3. Trigynia

Turnera

Order 4. Tetragynia



Parnassia, Grass of Parnassus.

Order 5. Pentagynia

Crassula, Navelwort

Order 6. Polygynia

Myosurus, Mouse Tail.

Class VI. Hexandria. Six Stamens in the Hermaphrodite Flower

Order 1. Monogynia

Amaryllis, Belladona

Order 2. Digynia

Oryza, Rice

Order 3. Trigynia

Rumex, great curled Dock.

Order 4. Tetragynia

Petiveria

Order 5. Polygynia

Alisma, great water Plantain.

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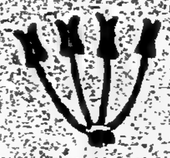
Grainger Sc.

Linnean System.

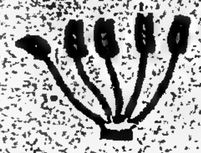
MONANDRIA.

DIANDRIA.

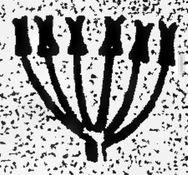
TRIANDRIA.



TETRANDRIA.



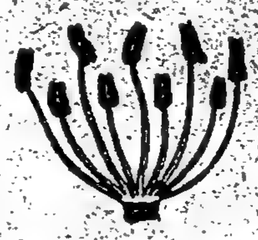
PENTANDRIA.



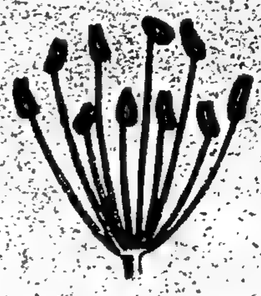
HEXANDRIA.

HEPTANDRIA.

OCTANDRIA.



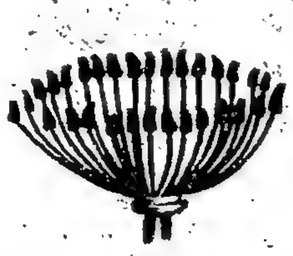
ENNEANDRIA.



DECANDRIA.

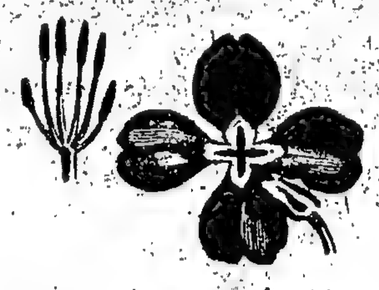
DODECANDRIA.

ICOSANDRIA.



POLYANDRIA.

DIDYNAMIA.



TETRADYNAMIA.

MONADELPHIA.

DIADELPHIA.

POLYADELPHIA.

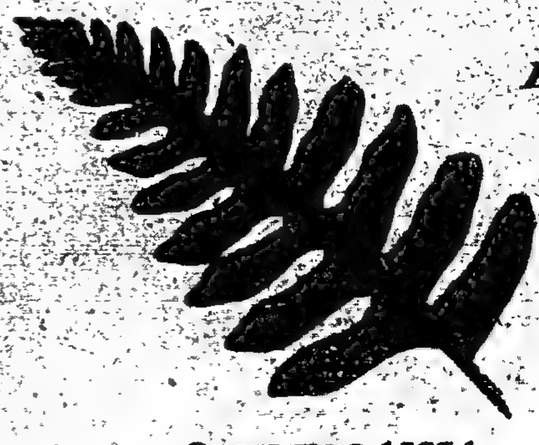
SYNGENESIA.

GYNANDRIA.

POLYGAMIA.

MONOECIA.

DIOECIA.



CRYPTOGAMIA.

London, Published by Alex.r Hogg, at the King's Arms, N.o 16, Paternoster Row.

THE LINNÆAN SYSTEM,

Containing the Various Orders or Claſſes of Flowers; ſuch are,

I. THOSE that have one ſtamen on the hermaphrodite flower, as,

The Indian Flowering Reed, or Cane, of which there are three ſpecies. 1. Common broad-leaved Flowering Cane. 2. Indian Flowering Cane, with a pale red flower. 3. Indian Cane, with glaucous leaves, and a very large flower — The Virgate Strawberry Blite. 1. Blite with ſpikes, terminated with little heads, or the common Strawberry Blite, or Strawberry Spinach. 2. Blite with ſmall heads growing ſcattered from the ſides of the ſtalks.

II. Two ſtamens in the hermaphrodite flower, as,

Oſwego Tea, having headed flowers; the ſtamina of which are almoſt in two bodies, and an acute angular ſtalk—Vernal Graſs—Black Pepper.

III. Three ſtamens in the hermaphrodite flower, as,

The Garden Crocus. 1. That with a ſpatha of one valve near the root, with a very long tube to the flower, being the cultivated, or true Saffron—2. The Crocus, with a two leaved ſpatha, and a ſhort tube to the flower—The wild Oat—and the Mollugo (verticillate.)

IV. Four ſtamens in the flower with the fruit, as,

Laciniated Teaſel—Witch Hazel, a genus of plants, of which there is but one ſpecies—Pond Weed.

V. Five ſtamens in the hermaphrodite flower, as,

Roſe Bay. 1. Oleander or Nerium, with linear, ſpear-ſhaped leaves, three at a joint. 2. Oleander, with ſpear-ſhaped, ovated leaves, and divaricated branches. 3. Oleander, with oval, accumulated foot ſtalks—Common Fennel, a biennial plant—Turnera. 1. With linear, ſpear-ſhaped, hairy leaves. 2. With oval, ſpear-ſhaped leaves, ſawed, and rough—Graſs of Parnaſſus. 1. Common Marſh-graſs of Parnaſſus. 2. Graſs of Parnaſſus, with double flowers—Navelwort. 1. Navelwort with roundiſh, plane, intire leaves. 2. Navelwort with ſemiglobular leaves. 3. Navelwort with oval crenated leaves, and a ſpiked ſtalk. 4. Navelwort with oblong pointed leaves ending with a ſpine, and a ſpiked ſtalk. 5. Navelwort with hooded leaves ſharply indented, and growing alternate, and a branching ſtalk with erect flowers. 6. Navelwort with cut leaves, and four pointed flowers.

The firſt and ſecond ſpecies are ſhrubby plants, and natives of the Cape of Good Hope. They flower in the months of July and Auguſt, but never ripen ſeeds in this country.

The third ſpecies is a biennial plant, and grows naturally in Crete and Siberia. The fourth is alſo a native of Siberia.

The fifth ſpecies grows upon old walls and other buildings in many parts of England and Portugal, and is ſeldom cultivated in gardens.

The ſixth ſpecies is a native of Egypt. It is a ſhrubby plant, and requires a warm ſtove to preſerve it through the winter in this country; nor ſhould it be expoſed abroad in ſummer, but kept in the ſtove, or placed in an airy glaſs caſe—Moule-tail.

VI. Six ſtamens in the hermaphrodite flower, as, Belladona—Rice—Great-curled Dock—Petiveria—and Great Water Plantain.

VII. Seven ſtamens in the ſame flower, with the piſtil, as,

Horſe Cheſnut—Lizard's Tail.

VIII. Eight ſtamens in the ſame flower with the piſtil, as,

The Tree Primroſe. 1. With oval ſpear-ſhaped, plain leaves. 2. With ſpear-ſhaped, waved leaves. 3. With ſpear-ſhaped leaves, and capſules which have acute angles. The firſt and third ſpecies are natives of Virginia, and the ſecond of Buenos Ayres—Galenia. It grows naturally at the Cape of Good Hope, and in other parts of Africa—Buck-Wheat—Tuberous Moſchatel.

IX. Nine Stamens in the hermaphrodite flower, as,

Caſſita (Berry-bearing)—Palmated Rhubarb—Flowering Ruſh.

X. Ten ſtamens in the hermaphrodite flower, as,

Calmia, narrow leaved — Saxifraga — Greater Stilchwort—Wood Sorrel, of which there are thirteen ſpecies, but five of theſe only are cultivated in gardens; viz. 1. Wood Sorrel, with a foot-ſtalk ſupporting one flower, trifoliate leaves, and a bulbous root. 2. Wood Sorrel, with one flower on a foot-ſtalk, and ſtalks divided by pairs. 3. Wood Sorrel, with an umbelliferous ſtalk, and trifoliate leaves, divided into two parts. 4. Wood Sorrel, with a branching, diffuſed ſtalk, and umbellated foot-ſtalks. 5. Wood Sorrel, with a branching, upright ſtalk, and umbellated foot-ſtalks.

The firſt, ſecond, and third ſpecies are natives of Africa. The fourth of Italy and Sicily; and the fifth of Virginia—American Nightſhade: of which moſt botaniſts enumerate a vaſt number of ſpecies, but ſome writers have reduced them to the twenty-three following. 1. Night-ſhade, with a ſhrubby, unarmed ſtalk, oval, hairy, entire leaves, and compound umbels. 2. Night-ſhade, with a ſhrubby, unarmed ſtalk, oval, entire leaves, and thread-like foot-ſtalks to the flowers, proceeding from the ſides of the branches. 3. Night-ſhade, with a ſhrubby, unarmed ſtalk, ſpear-ſhaped leaves, turning inward, and umbels ſitting cloſe to the ſtalks. 4. Night-ſhade, with a ſhrubby, unarmed ſtalk, leaves growing in pairs, one of which is bigger than the other, and cymoſe flowers. 5. Night-ſhade, with a ſhrubby, bended, and unarmed ſtalk, the upper leaves ſpear-ſhaped, and bunches of flowers at the top of the ſtalk, commonly called Bitter-ſweet. 6. Night-ſhade, with a ſhrubby, bended, and unarmed ſtalk, oblong, ſinuated leaves at the ſides of the ſtalk, and bunches of flowers at the top of the ſtalk. 7. Night-ſhade, with a ſhrubby, almoſt unarmed ſtalk, and wedge-ſhaped, ſinuated leaves, turning backward. 8. Night-ſhade, with an herbaceous, unarmed ſtalk, and entire, winged leaves. 9. Night-ſhade, with an unarmed, herbaceous ſtalk, cut, winged leaves, and ſingle bunches of flowers, or Pomum amoris. 10. Night-ſhade, with an herbaceous, unarmed ſtalk, cut, winged leaves, bunches of reflexed flowers divided into two parts, and hairy berries. 11. Night-ſhade, with an herbaceous, unarmed ſtalk, and heart-ſhaped leaves, turning inward. 12. Night-ſhade, with an unarmed, herbaceous ſtalk, oval, indented, angular leaves, and nodding umbels; or the common Night-ſhade of the ſhops, with a black fruit. 13. Night-ſhade, with an unarmed, herbaceous ſtalk, oval, hairy, intire leaves, and prickly cups; or the Melongena, Mad-apple, or Egg-plant. 14. Night-

Night-ſhade, with a prickly, herbaceous ſtalk, heart-ſhaped, ſinuated leaves, and prickly cups. 15. Night-ſhade, with a prickly, herbaceous ſtalk, and heart-ſhaped leaves with five lobes, hairy, and prickly on both ſides, commonly called Batchelor's Pear. 16. Night-ſhade, with a prickly, herbaceous ſtalk, winged leaves, ſinuated, obtuſe ſegments, and prickly cups. 17. Night-ſhade, with a prickly, ſhrubby ſtalk, angular, woolly, intire leaves, prickly on both ſides, and unarmed cups. 18. Night-ſhade, with a prickly, ſhrubby ſtalk, ſpear-ſhaped, angular leaves, prickly on both ſides, and looſe bunches of flowers. 19. Night-ſhade, with recurved thorns on the ſtalks, and ſinuated leaves, downy on their under-ſide, prickly on both ſides, and the foot-ſtalks of the flowers prickly. 20. Night-ſhade, with a prickly, ſhrubby ſtalk, leaves turned inſide, and prickly cups. 21. Night-ſhade, with a prickly, ſhrubby ſtalk, heart-ſhaped, hairy leaves, turned in at the brim, and unarmed cups. 22. Night-ſhade, with a prickly, ſhrubby ſtalk, and ſpear-ſhaped, angular, indented leaves. 23. Night-ſhade, with a prickly, ſhrubby ſtalk, ſmooth, obtuſe, unarmed leaves, with three lobes.

Theſe plants are natives of Europe, Aſia, Africa, and America, but moſt of them grow naturally in America.

XI. Stamens with twelve, nineteen in the hermaphrodite flower, as,

Aſarum, Aſarabacca. 1. With kidney-ſhaped leaves, having two blunt points, or the common Aſarabacca. 2. Aſarum, with kidney-ſhaped leaves, ending in a point. 3. Aſarum, with blunt, heart-ſhaped, ſmooth leaves, with foot ſtalks. 4. Aſarum, with ſeſſile imbrecated leaves, and flowers cut into four parts, or the hypociſt. Theſe are perennial plants: the firſt grows in ſome parts of England, and other countries of Europe. The ſecond is a native of Canada. The third grows naturally in Virginia, Maryland, and Carolina; and the fourth is a native of Spain and Portugal—Agrimonia—Euphorbia (Lathyris)—Sempervivum, Houſeleek: of which are ſeven ſpecies. 1. Houſeleek with a ſmooth, tree-like, branching ſtalk, or Tree Houſeleek. 2. Houſeleek with ſtalks torn by the rudiments of the leaves, and blunt pointed leaves. 3. Houſeleek with hairy edged leaves, and ſpreading off-ſets, or the common large Houſeleek. 4. Houſeleek, with hairy edged leaves, and globular off-ſets. 5. Houſeleek with threads from leaf to leaf, and globular off-ſets. 6. Houſeleek with entire leaves, and ſpreading off-ſets. 7. Houſeleek with leaves, whoſe borders are indented like a ſaw, and ſpreading off-ſets.

The firſt ſpecies grows at the Cape of Good Hope, and in Portugal. The ſecond is a native of the Canary Iſlands. The third is found growing on the tops of houſes and walls in England. The fourth is a native of the northern parts of Europe. The fifth grows upon the Alps and Helvetian mountains. The ſixth upon the latter: and the ſeventh is a native of the Cape of Good Hope.

XII. The ſtamens inſerted in the inſide of the calyx; and commonly twenty, or more, as,

Punica, the Pomegranate. There is only one ſpecies of this genus with the following varieties. The wild, with ſingle and double flowers. The ſmall flowering with ditto. The Pomegranate with ſtriped flowers; and the Sweet Pomegranate. The Tree is a native of Italy, Spain, and Africa—The Bean-tree — Quicken-tree — Codlin-apple — The Bramble.

XIII. The ſtamens from twenty to a hundred in the ſame piſtil with the flower, as,

Sarracenia—The Piony—Wolfs-bane—Columbine. 1. With crooked nectaria, called Double Starry. 2. With ſtraight nectaria, ſhorter than the petals, which are ſharp-ſpeared. 3. With ſtraight nectaria, and ſtamina longer than the flower petals. The firſt ſpecies grows naturally in moſt countries of Europe. The ſecond is a native of Switzerland, and the third of Virginia and Canada.—Water Aloe, of which there are fourteen ſpecies. 1. Aloe, with nodding flowers, growing upon foot-ſtalks, in form of a cylindrical corymbus, or the common Aloe. 2. Aloe, with nodding, branching, priſmatic flowers, growing upon foot-ſtalks, and ſpreading equally at the brim, commonly called Partridge-breaſt Aloe. 3. Aloe, with flowers growing upon foot-ſtalks, and the foot-ſtalks oval, cylindric, and crooked. 4. Aloe, with ſeſſile, horizontal, funnel-ſhaped, equal flowers, turned back at the brim. 5. Aloe, with ſeſſile, oval, crenated flowers, and the interior ſegments connivent. 6. Aloe, with ſeſſile, triquetrous, two-lipped flowers, and the upper lip turned back, commonly called Cuſhion Aloe. 7. Aloe, with ſeſſile, funnel-ſhaped, two lipped flowers, cut into five revolute ſegments, erect at the top. 8. Aloe, with ſeſſile, two lipped flowers, the upper lip erect, and the under one ſpreading, commonly called Large Pearl-Aloe. 9. Aloe, with ſeſſile, reflexed, imbrecated, priſmatic flowers. 10. The common Barbadoes Aloe. 11. The Socotrine Aloe. 12. The Cobweb Aloe. 13. The Guinea Aloe. 14. The Ceylon Aloe.

Of theſe ſpecies there are a vaſt variety, particularly of the firſt ſort: they are all perennial plants, and natives of Africa, and the Indies—Crowfoot. In the gardens four kinds of the Ranunculus are particularly attended to, namely, the Double White—Proliferous Mountain—Golden Proliferous—and Oriental Meadow.

XIV. Four ſtamens; two of which are cloſe together, and longer, as,

Melittis—Honey Flower.

XV. Six ſtamens, four long, the two oppoſite ſhort, as,

Honeſty—and the Stock July Flower.

XVI. The filaments of the ſtamens grown together into one body, as,

Hermannia—African Cranes-bill. Of this genus Linnæus diſtinguiſhes thirty-nine ſpecies; and Tournefort ſeventy-eight, too great a number to be inſerted in this work.—Indian Vervain Mallow. 1. With angulated leaves. 2. With ſinuated, hairy, many pointed leaves. 3. With ſpear-ſhaped, heart-ſhaped, undivided, ſawed leaves, and a trailing ſtalk—Roſe Mallow, a ſpecies of the Hollyhock. 1. With angular ſinuated leaves. 2. With palmated leaves.

XVII. The filaments of the ſtamens grown together into two bodies, as,

Yellow Fumatory, of which there are eleven ſpecies. 1. Fumatory, with a naked ſtalk; or the Cucullaria. 2. Fumatory, with bilobated flowers behind, and a leafy ſtalk. 3. Fumatory, with a ſimple ſtalk, and bracteæ as long as the flowers. 4. Fumatory, with narrow pods, growing in panicles, and an erect ſtalk, called Baſtard Fumatory. 5. Fumatory, with narrow, four-cornered pods, and diffuſed ſtalks, with acute angles; or the Capnoides. 6. Fumatory, with three trifoliate leaves, and the ſmall leaves heart-ſhaped. 7. Fumatory, with the ſeed-veſſels growing in a racemus, containing a ſingle ſeed, and a diffuſed ſtalk; or the common Fumatory. 8. Fumatory, with ſeed-veſſels growing

growing in a ſpike, containing one ſeed, an upright ſtalk, and filiform, or thread-like leaves. 9. Fumatory, with ſeed-veſſels growing in a racemus, containing a ſingle ſeed, and climbing leaves, with ſhort tendrils. 10. Fumatory, with narrow pods, and leaves with claſpers. 11. Fumatory, with globular, inflated pods.

The firſt three ſpecies are perennial plants: the firſt grows naturally in North America, the ſecond in Siberia, and the third in ſhady and woody places throughout Europe.

The other ſpecies of this genus are annual plants. The fourth ſort grows naturally in North America, and is a proper plant to grow on the ſides of grottos, or rock-work, where by its continuing green all the year, and its long continuance in flower, it has a good effect.

The fifth ſort is a native of France, Italy, and Mauritania, and the ſixth grows naturally in rocky places in Spain and Sicily; theſe plants are alſo proper for the joints of grottos, or any rock-work.

The ſeventh ſpecies is a native of Europe, and particularly of this country; the eighth ſort is a native of France, Spain, and Italy.

The ninth ſpecies is a native of France and England; and the tenth is alſo a native of rocky places in England. The eleventh ſort grows naturally at the Cape of Good Hope—Milkwort. Linnæus diſtinguiſhes no leſs than twenty-two ſpecies of this plant, but the three following only are to be met with in our Engliſh gardens. 1. Milkwort, with creſted flowers, a moon-ſhaped keel, and a ſhrubby ſtalk, having oblong leaves, which end in obtuſe petals. 2. With flowers growing thinly, and without beards; the point of the keel roundiſh, a ſhrubby ſtalk, and ſpear-ſhaped leaves. 3. With ſpiked flowers, without beards, an erect, ſingle, herbaceous ſtalk, and broad ſpear-ſhaped leaves—Everlaſting-pea.

XVIII. The filaments of the ſtamens grown together, into three or more bodies, as,

Theobrama—Orange. 1. The common Seville. 2. The China. 3. The Willow leaved, or Turkey. 4. The Pampelmoes, or Shaddock. 5. The Dwarf or Nutmeg.—St. John's-wort.

XIX. The ſtamens, and anthera's grown together in form of a cylinder. Theſe have rarely filaments, as,

Dandelion—Xeranthemum—Sun-Flower, of which there are ten ſpecies. 1. Sun-flower, with all the leaves heart-ſhaped, veins uniting behind at the baſe, but towards the border naked; commonly called Annual Sun-flower. 2. Sun-flower, with the under leaves heart-ſhaped, veins uniting behind at their baſe, and the upper leaves oval; commonly called Perennial Sun-flower. 3. Sun-flower, with oval, heart-ſhaped leaves, with the nerves uniting in the leaf; commonly called Jeruſalem Artichoke. 4. Sun-flower, with a ſtalk ſmooth on the underſide, heart-ſpear-ſhaped leaves, and ten petals in the rays. 5. Sun-flower, with a ſpindle-ſhaped root. 6. Sun-flower, with rough, ſpear-ſhaped leaves, and a ſlender ſtalk, ſmooth towards the bottom. 7. Sun-flower, with ſmooth, ſpear-ſhaped, ſawed leaves. 8. Sun-flower, with narrow leaves. 9. Sun-flower, with oblong, oppoſite, oval, ſeſſile leaves, three veins, and a dichotomous panicle. 10. Sun-flower, with oval, rough, crenated leaves, with three nerves, the ſcales of the cup erect, and as long as the diſk of the flower.

All theſe ſpecies are natives of different parts of America. The ſecond ſort is moſt proper for large borders in great gardens; it begins flowering in July, and continues till October—The Marigold, of which there are ſeven ſpecies. 1. Marigold with narrow, ſpear-ſhaped leaves, and prickly ſeeds, or the leaſt Marigold. 2. Marigold, with boat-ſhaped, prickly ſeeds in the border, and thoſe in the center bicorned. 3. Marigold, with ſpear-ſhaped, indented leaves, and ſlender foot-ſtalks. 4. Marigold, with ſinuated, indented, ſpear-ſhaped leaves, and a naked ſtalk. 5. Marigold, with indented, ſpear-ſhaped leaves, and the upper part of the foot-ſtalk ſwelling. 6. Marigold, with narrow, entire leaves, and a naked ſtalk. 7. Marigold, with obverſe, oval leaves, which are indented, and a perennial ſhrubby ſtalk.—Globe Thiſtle. 1. The Greater. 2. The Smaller. 3. With a large head. 4. With a ſmall blue head.

The firſt ſpecies is a native of Italy and Spain; the ſecond of France and Italy; the third of Spain; and the fourth of Greece—Cardinal-Flower, a genus of plants, of which there are ten ſpecies. 1. Cardinal-Flower, with an erect ſtalk, ſpear-ſhaped, ſawed leaves, and a ſpike of flowers, terminating the ſtalk, commonly called Scarlet Cardinal-Flower. 2. Cardinal-Flower, with an erect ſtalk, linear, ſpear-ſhaped, entire, acute-pointed leaves, and a ſpike of flowers terminating the ſtalk. 3. Cardinal-Flower, with an erect ſtalk, oval, ſpear-ſhaped, crenated leaves, and the ſinuſes of the impalements reflexed, commonly called the Blue Cardinal-Flower. 4. Cardinal-Flower, with an erect ſtalk, heart-ſhaped leaves, which are ſomewhat indented, having foot-ſtalks, and the longeſt ſpike of flowers, which are placed thinly. 5. Cardinal-Flower, with an erect ſtalk, the lower leaves roundiſh and crenated; the upper ſpear-ſhaped, ſawed, and a ſpike of flowers terminating the ſtalk. 6. Cardinal-Flower, with an erect ſtalk, oval leaves, which are ſomewhat ſawed, longer than the foot-ſtalk, and ſwelling ſeed-veſſels. 7. Cardinal-Flower, with oval, crenated leaves, which are downy, and flowers growing ſingly from the ſides of the ſtalk. 8. Cardinal-Flower, with ſpear-ſhaped, indented leaves, very ſhort foot-ſtalks to the flowers, which proceed from the ſides of the ſtalks, and a very long tube to the petal. 9. Cardinal-Flower, with a ſpreading, branching ſtalk, ſpear-ſhaped leaves, which are ſomewhat indented, and very long foot-ſtalks to the flowers. 10. Cardinal-Flower, with trailing ſtalks, ſpear-ſhaped, ſawed leaves, and foot-ſtalks proceeding from their ſides.

The varieties are natives, or grow naturally in North America, at Campeachy, Virginia, Jamaica, Blois in France, and at the Cape of Good Hope. The third ſort has a perennial fibrous root; the fourth is an annual; the ſixth and ſeventh are biennial plants.

XX. The ſtamens inſerted on the piſtil; but not on the receptacle, ſuch as,

Orchis—Siſyrinchium, Bermudiana—Paſſion-Flower. Of this genus of plants are no leſs than twenty four ſpecies mentioned by Linnæus; a particular deſcription of all which would be needleſs, as they bear a great reſemblance to each other; one, the moſt beautiful is the Laurel-leaved Paſſion-Flower, a native of South America.—Birthwort—and Cuckow Pint.

XXI. Male and female flowers on the ſame plant, ſuch as,

Triple-headed Pond Weed—Tripſicum—Roman Nettle—Parthenium—Walnut—Scotch Fir—Male Balſam Apple—Baſtard Orpine, a native of France.

XXII. The male flowers on a different plant from the female, as,

The Hop—White Miſſelto—Crow-berries—Brown Willow—Dogs Mercury—Black Poplar—Bryony

Bryony — Clifortia — Moon-seed — Kiggelaria — Pulchella — Butcher's Broom — Juniper.

XXIII. Hermaphrodite, or male and female flowers on the same plant, such as, The Common Fig — Flowering Ash — White Hellebore.

XXIV. Flowers within the fruit, or imperceptible to the eye, as, Polypodium — Bryum (matted) Fucus — Agaric (field.)

Such is the Linnæan System of the different genera, and orders of flowers; to which we have added two places, and half a one, under the title of leaves, wherein are distinguished by Linnæus, the cups and other parts of flowers, (as sexes, &c.) ranged under their different orders, as, Monogynia, Digynia, Monandria, Diandria, &c. &c. We proceed now to

TOURNEFORT's SYSTEM of FLOWERS.

IN this the genera, or different kinds of plants are included in twenty-two classes; to which is prefixed general and classical characters of flowers. It is unnecessary to enter upon the particular plants, trees, shrubs, flowers, &c. enumerated under each class in this system, since most of them have been described either in the former one or in the Natural History of Vegetables, page 296; and to find the latter, the reader has only to consult the Index under the head of Botany. To these we have added a Plate of the Abutillon, with leaves resembling those of a red gooseberry-tree; having a flesh-coloured flower, and fruit of a pentagonal, or five cornered shape, and rough tasted; and the Hairy Abutillon of the shrub kind, with a roundish leaf, a large and spreading flower of a pale colour, and a single cup and calix. We have likewise given another plate of various objects in Natural History, as Feathers, Death Watch, Fibres, Plants, Water Spout, Seed, &c.

LEAVES.

BOTANISTS consider the leaves with regard to their structure, surface, shape, consistence, edges, situation, and size: with regard to their structure, they are either single, as those of the apple, pear, and plumb-tree, or compound, as those of the strawberry, parsley, &c. a single leaf is one which is either immediately joined to the branch, or connected with it by a foot-stalk; a leaf is said to be compound, when there are more than one upon a petiole or foot-stalk: with respect to their surface, they are either flat, as the origany, or in bunches, as the houseleek: with regard to their shape, they are either lanceolated, cordated, acuminated, hastated, &c. and are either thin and fine, as those of the hypericum; or thick and gross, as those of purslane; or fleshy, as those of several kinds of aloes; or woolly, as those of marshmallows: with regard to their edges, leaves are cut slightly, as in some species of geums, or deep, as in some of the centaurys: with respect to their situation, they are either ranged alternately, as the alaternus; or opposite to each other, as the phillyrea, mint, balm, &c. with regard to their size, they are either very large, as those of the musa; or moderate, as those of the fig and vine; or small, as those of the elm or apple tree; or very small, as those of the heath, phylica, &c. See the Plate of Leaves.

Many sorts of plants, whose roots issue forth from the small end of the seed, put out two small leaves that are very unlike those which the plant afterwards produceth; for as soon as the root has taken hold of the ground, between these false leaves (commonly called the seed-leaves) there comes forth a shoot, which produces leaves like those of the mother plant; of this manner of growth there is an infinite number of plants.

Dr. Grew observes, that the fibres of leaves consist of two general kinds of vessels, viz. for sap and for air: and are ramified out of greater into less, as veins and arteries are in animals.

Mr. Frederick of Augsbourg, a celebrated gardener, took from the tree a leaf of the opuntia or Indian fig-tree, and setting it in the earth, it immediately took root, and produced blossoms and fruit.

The distinction of leaves, made by those who have written on botany, are the following:

A simple leaf is that which is not divided to the middle.

A compound leaf is divided into several parts, each resembling a simple leaf, as in liquorice, &c.

A digitated leaf is a compound leaf, divided into several parts, all of which meet together at the tail, as in the hemp, black hellebore, &c.

A trifoliated leaf is a digitated leaf, consisting of three fingers, as the trefoil, &c.

A quinquefoliated leaf is a digitated leaf, consisting of five fingers, as in the quinquefolium.

A pennated leaf is a compound leaf divided into several parts, each of which is called a lobe, placed along the middle rib, either alternately, or by pairs. When the middle rib is terminated by an odd lobe, it is said to be unequally pennated, as in the goats rue, &c. and equally pennated, when it is not terminated by an odd lobe, as in the cassia; when the lobes are all nearly of the same form and bigness, it is called an uniform pennated leaf, as in the liquorice; when they are not so, it is said to be difform, as in the agrimonia.

A winged leaf is, as it were, divided into several pennated leaves, as in the orobus, &c.

A ramose leaf is that which is still farther divided than the winged leaf, as in the osmund royal, female fern, &c.

An entire leaf or lobe is that which has no division on its edges, as in the apple-tree, &c.

A sinuated leaf is that which is cut about the edges into several long segments, as in common mallows.

A serrated leaf is that which is cut about the edges into several acute segments, resembling the teeth of a saw, as in the nettle, &c.

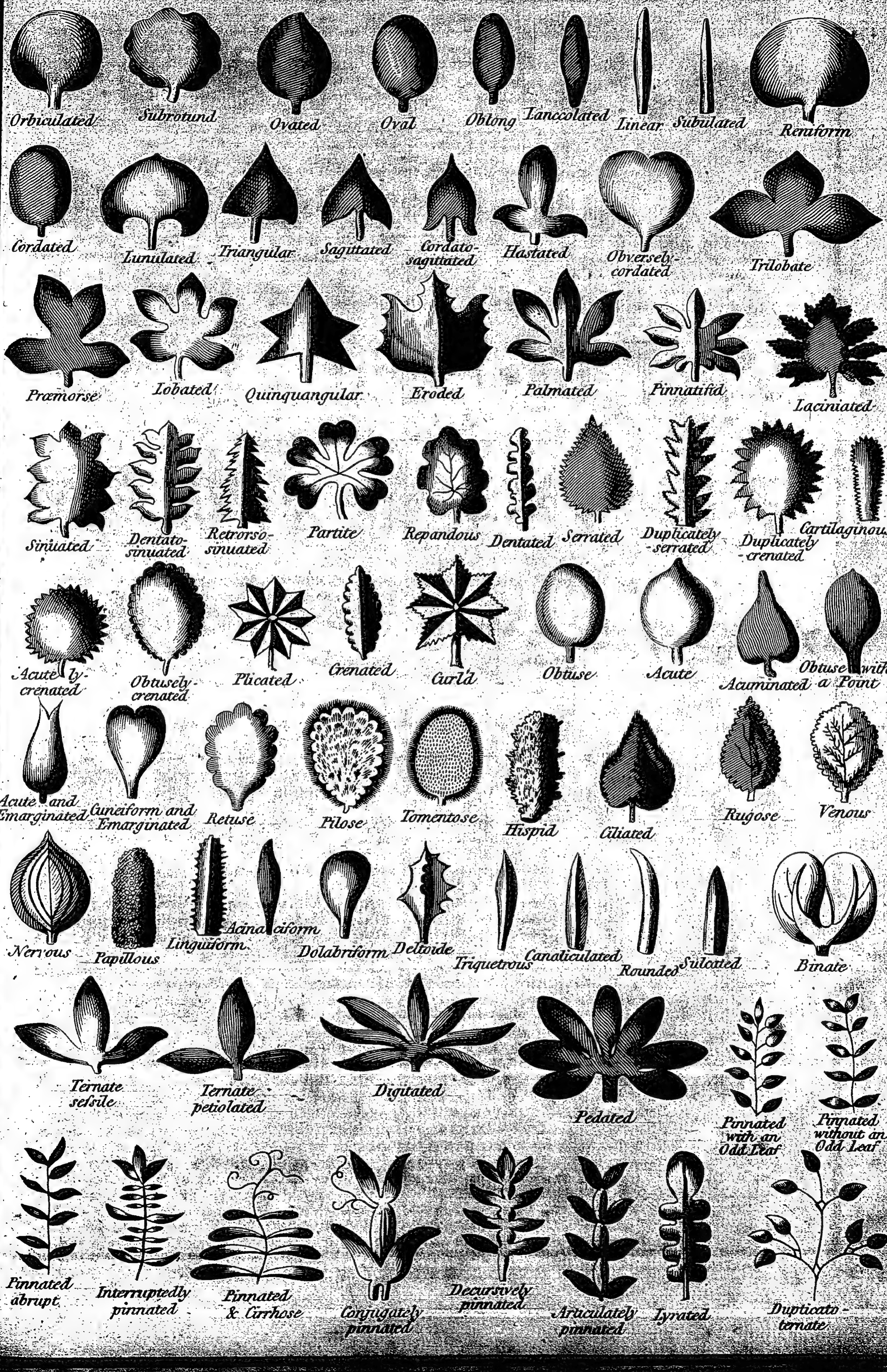
A crenated leaf is that which is cut about the edges into several obtuse segments, as in the betony, &c.

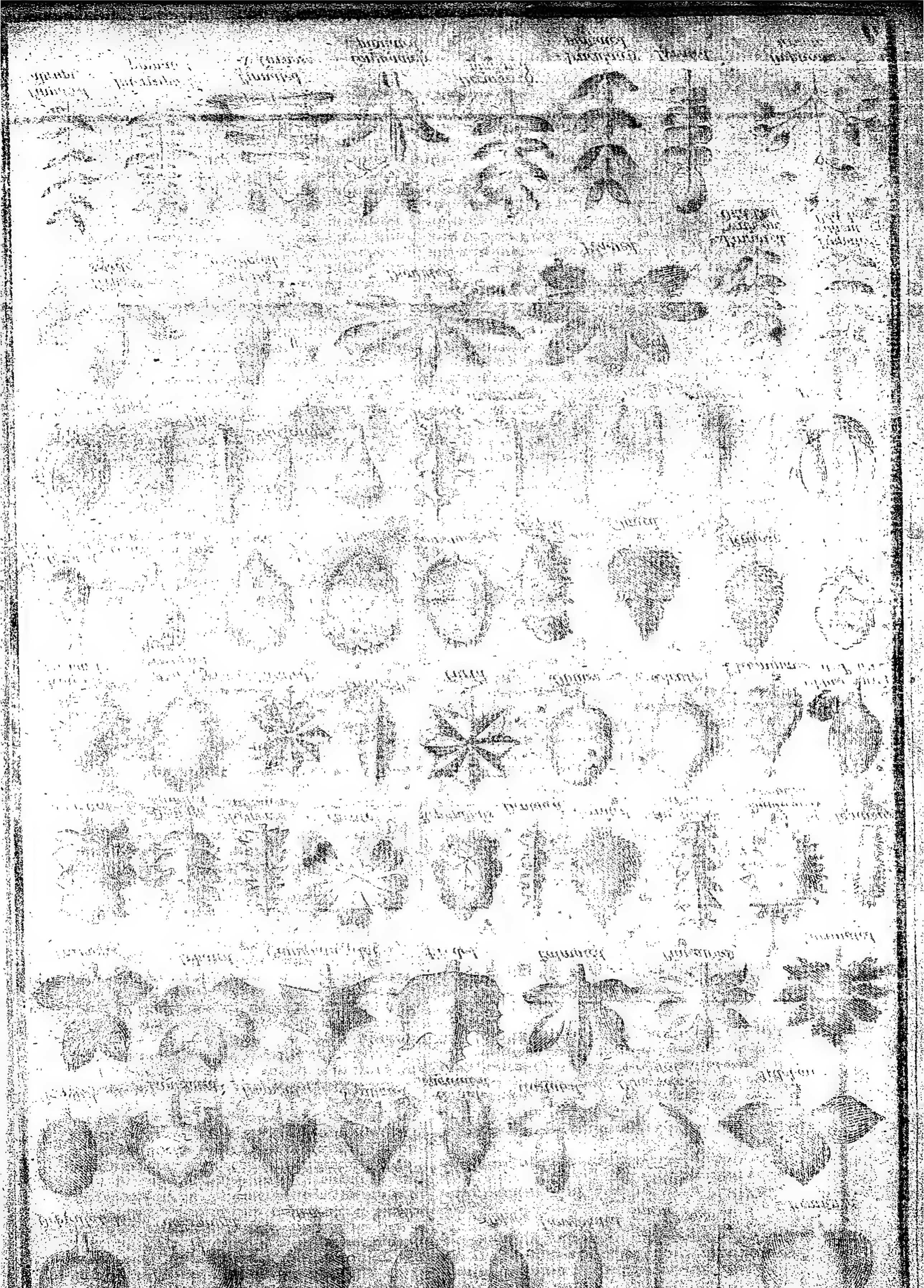
A laciniated or jagged leaf is that which is cut about the edges into several pretty deep portions, in an irregular manner, as in the horned poppy, &c.

If the surface of the leaves are altered, by reversing the branches of the trees on which they grow, the plants are stopped in their growth, until the foot-stalks are turned, and the leaves recover their former position. This shews how necessary it is to support all those weak shoots of plants, which are naturally disposed for upright growth, which neither twine about the neighbouring trees for support, or that put out claspers, by which they take hold of whatever trees or plants grow near them, and are thereby supported; and, on the contrary, how absurd is that practice of tying up the shoots of those plants which are naturally disposed to trail upon the ground, for in both these cases nature is reversed, and consequently the growth of both sorts of plants is greatly retarded.

This is one of the great functions for which the leaves of trees and plants are designed; but, besides this,

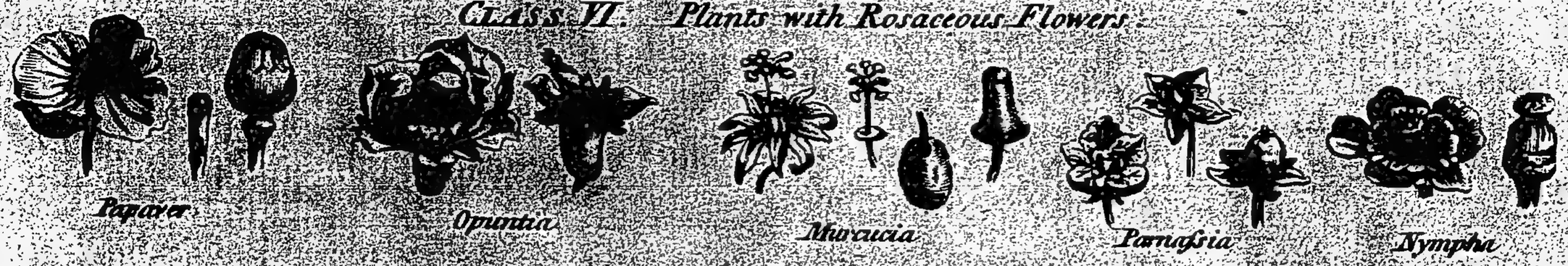
LEAVES.


Orbiculated
Subrotund
Ovated
Oval
Oblong
Lanceolated
Linear
Subulated
Reniform
Cordated
Lunulated
Triangular
Sagittated
Cordato-sagittated
Hastated
Obversely-cordated
Trilobate
Præmorse
Lobated
Quinquangular
Eroded
Palmated
Pinnatifid
Laciniated
Sinuated
Dentato-sinuated
Retrorso-sinuated
Partite
Repandous
Dentated
Serrated
Duplicately-serrated
Duplicately-crenated
Cartilaginous
Acutely-crenated
Obtusely-crenated
Plicated
Crenated
Curl'd
Obtuse
Acute
Acuminated
Obtuse with a Point
Acute and Emarginated
Cuneiform and Emarginated
Retuse
Pilose
Tomentose
Hispid
Ciliated
Rugose
Venous
Nervous
Papillous
Linguiform
Acinaciform
Dolabriform
Deltoide
Triquetrous
Canaliculated
Rounded
Sulcated
Binate
Ternate sessile
Ternate petiolated
Digitated
Pedated
Pinnated with an Odd Leaf
Pinnated without an Odd Leaf
Pinnated abrupt
Interruptedly pinnated
Pinnated & Cirrhose
Conjugately pinnated
Decursively pinnated
Articulately pinnated
Lyrated
Duplicato-ternate



Tournefort's System
GENERA of PLANTS.

CLASS VI. Plants with Rosaceous Flowers.



CLASS VII. Plants with Umbellated Polypetalous Rosaceous Flowers.

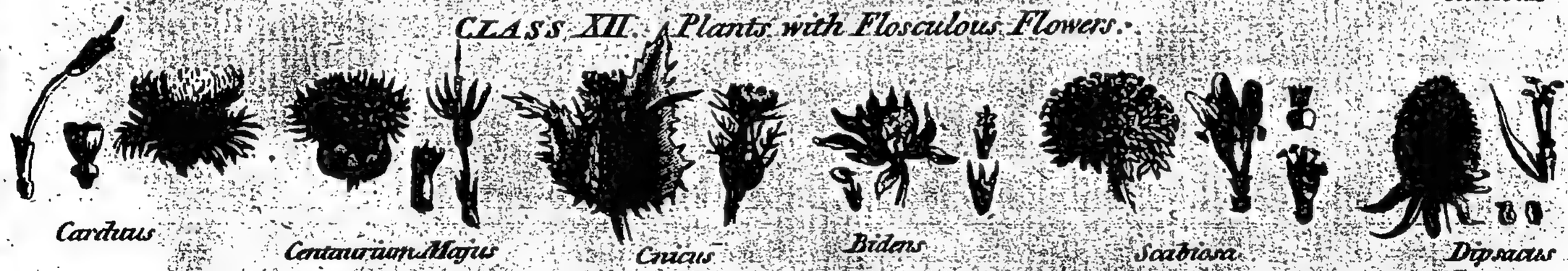
CLASS VIII. Plants with Polypetalous Caryophylleous Flowers.

CLASS IX. Plants with Liliaceous Flowers.

CLASS X. Plants with Polypetalous Papilionaceous Flowers.

CLASS XI. Plants with Polypetalous Anomalous Flowers.

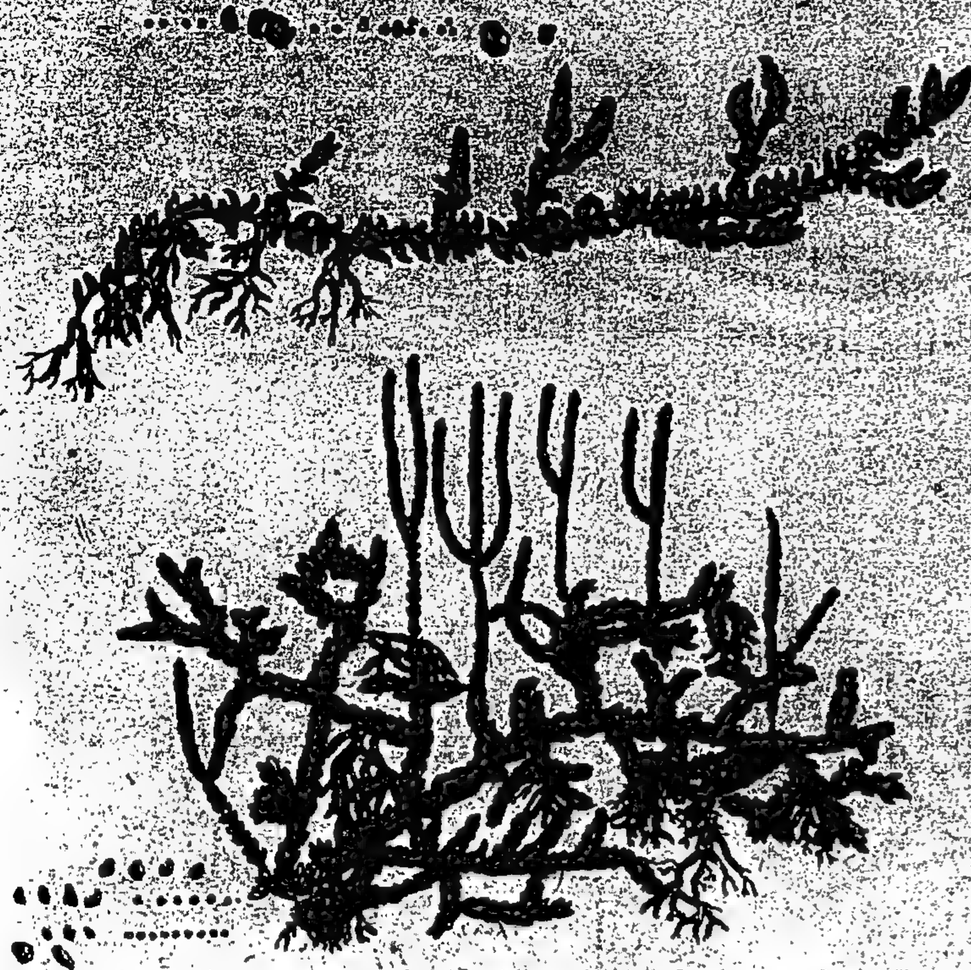
CLASS XII. Plants with Flosculous Flowers.



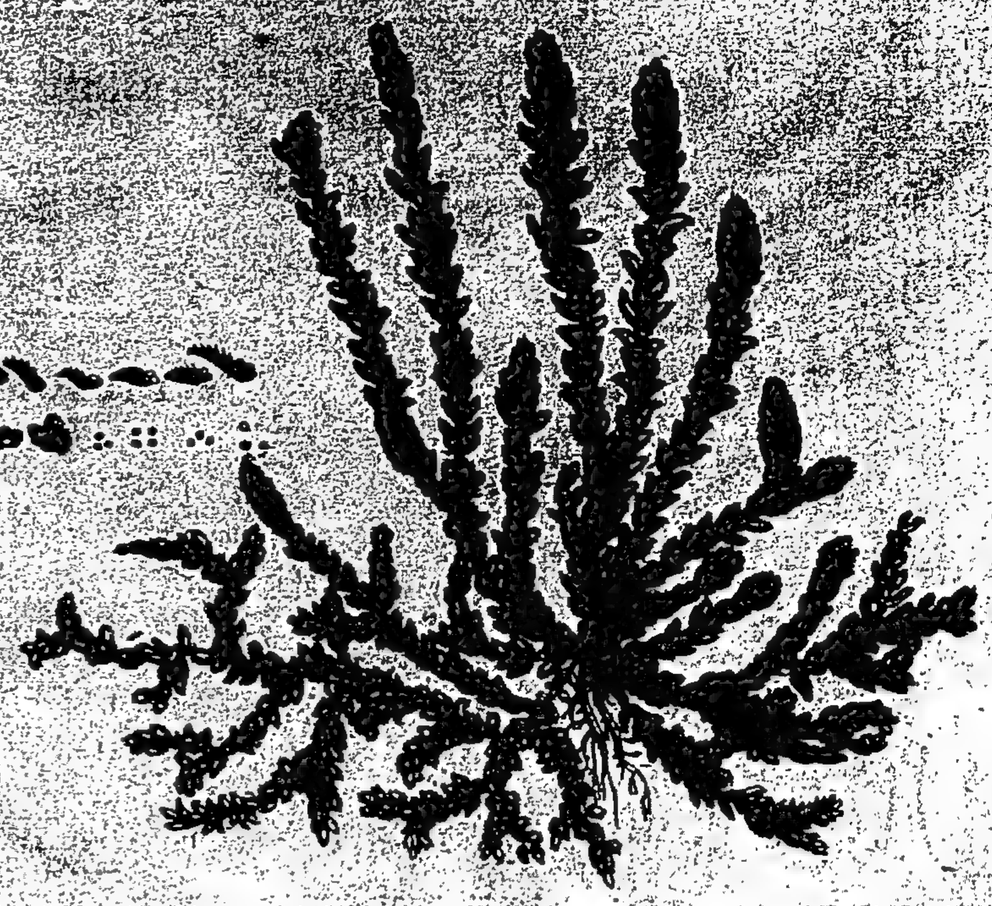
CLASS XIII. Plants with Semiflosculous Flowers.

London. Published by Alex. Hogg, N.° 16, Paternoster Row.

Genera of MOSSES.

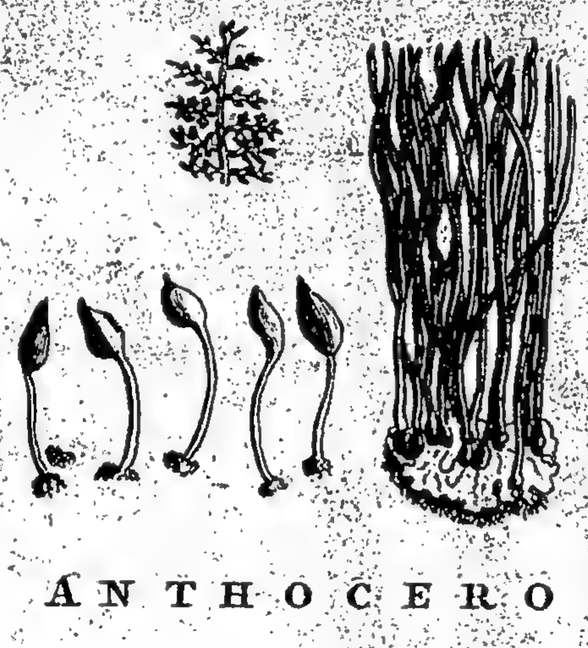


LYCOPODIOIDES



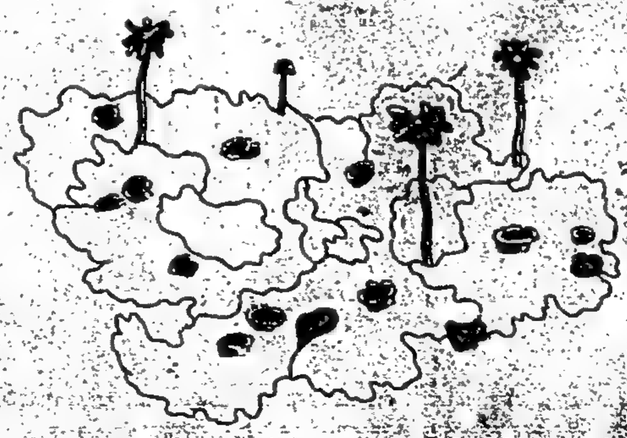
SELAGINOIDES

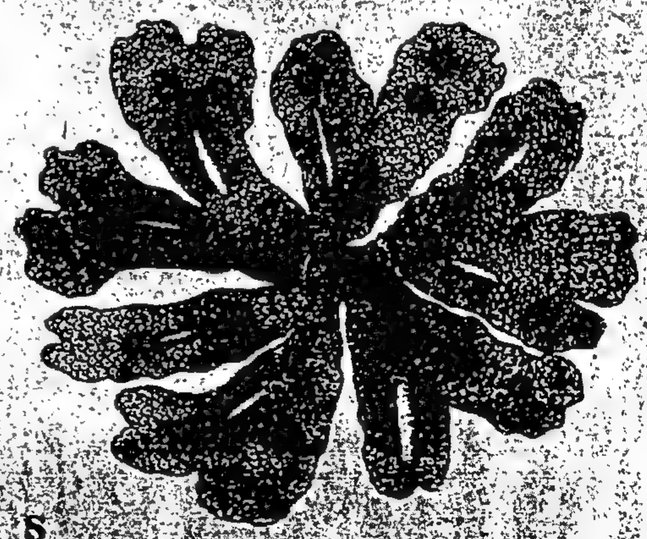
PORELLA



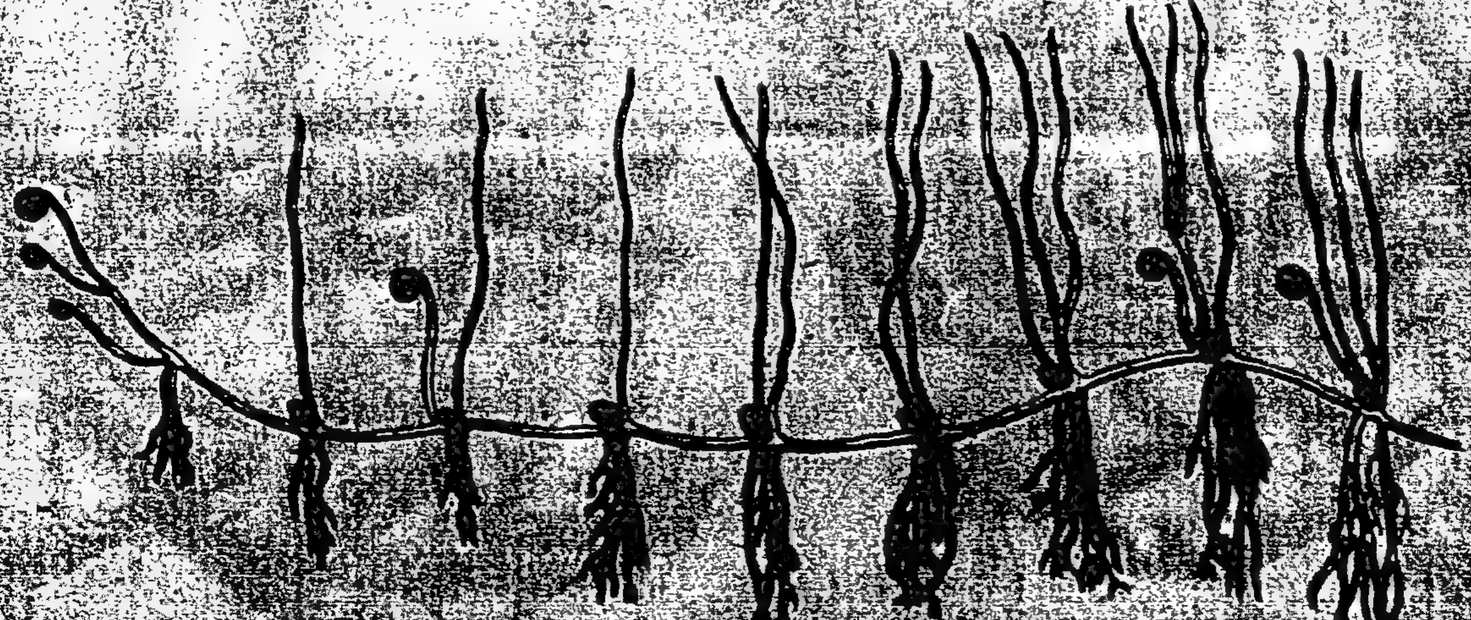
ANTHOCEROS

LICHENASTRA

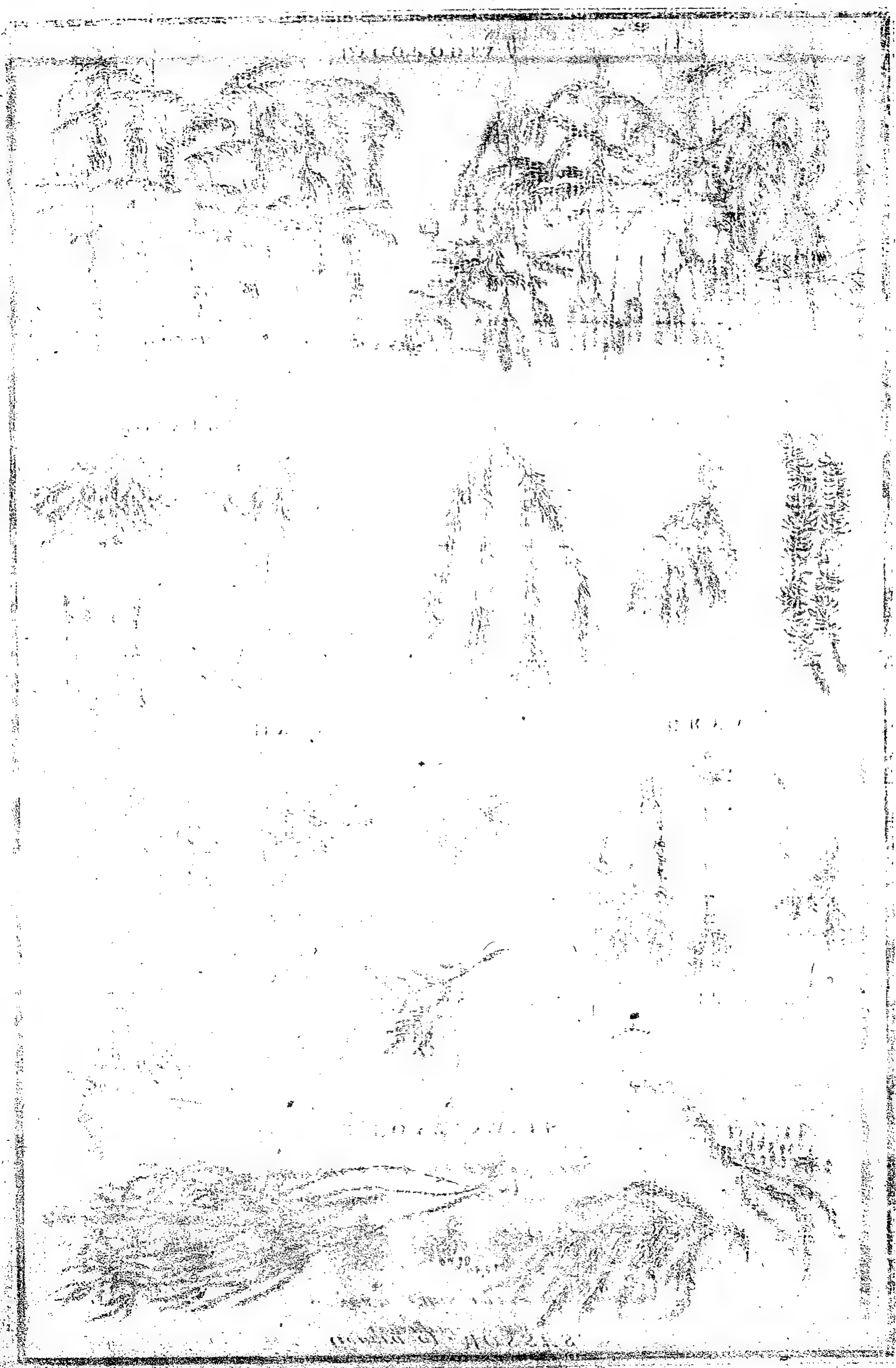




LICHENES



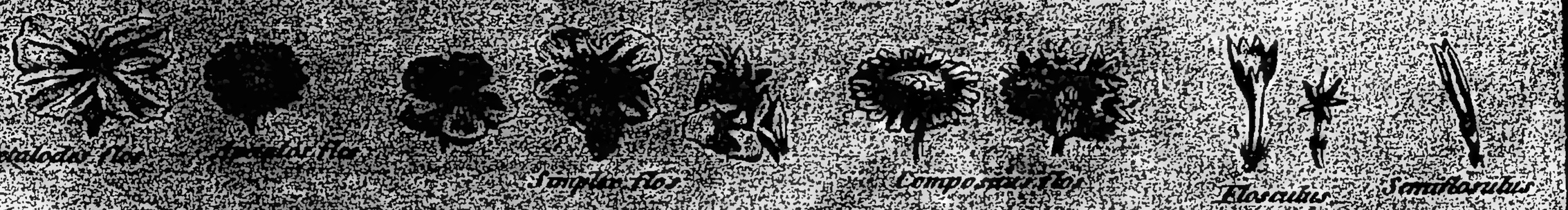
PILULARIA



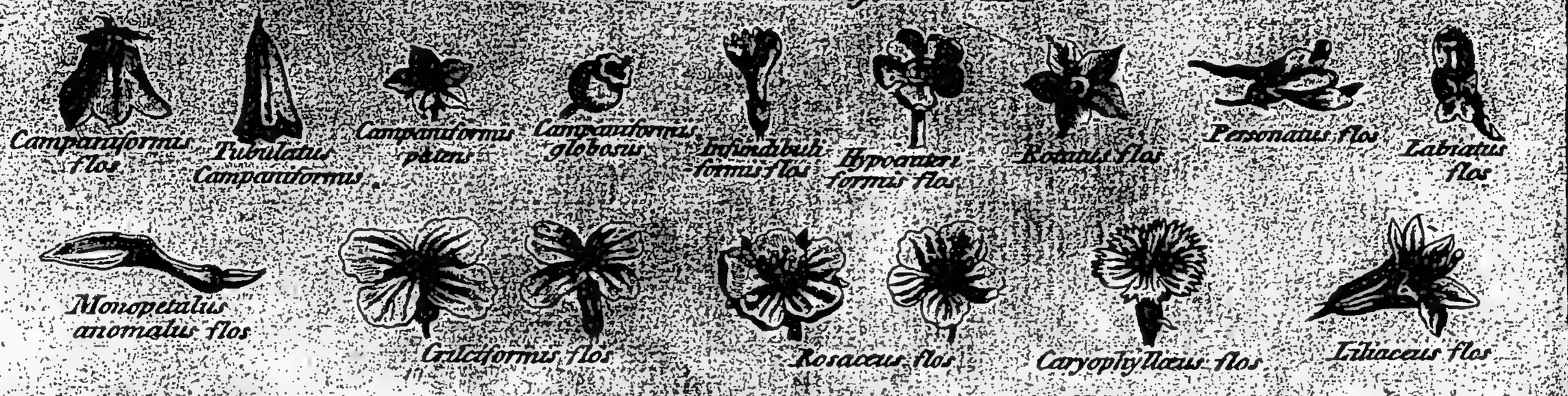
BOTANY

Tournefort's System

GENERAL CHARACTERS of FLOWERS



CLASSICAL CHARACTERS of FLOWERS



GENERA of PLANTS

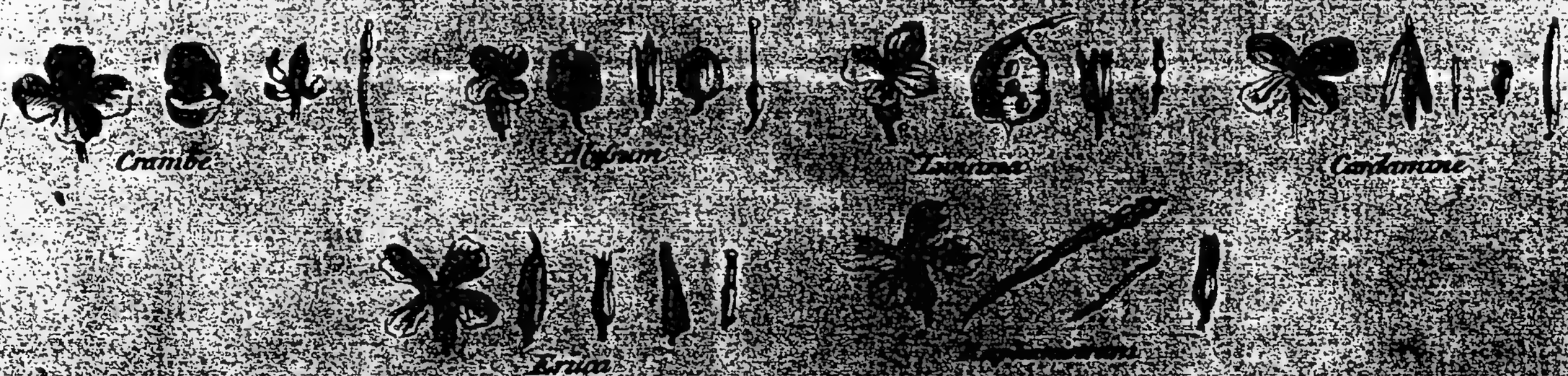
CLASS I. Plants with Monopetalous Campaniform Flowers

CLASS II. Plants with Monopetalous Infundibuliform & Rotated Flowers

CLASS III. Plants with Monopetalous Anomalous Flowers

CLASS IV. Plants with Monopetalous Labiated Flowers

CLASS V. Plants with Cruciform Polypetalous Flowers



London, Published by Alex.r Hogg at the King's Arms, N.o 72 Paternoster Row.

ROMA

ABUTILON.

with leaves resembling those of a red goose-berry-tree, a flesh coloured flower, & fruit of a pentagonal or five cornerd shape, & rough tasted.

The Hairy ABUTILON *of the* Shrub *kind, with a roundish leaf, a large and spreading flower of a pale yellow colour, and a single Cup or Calix.*

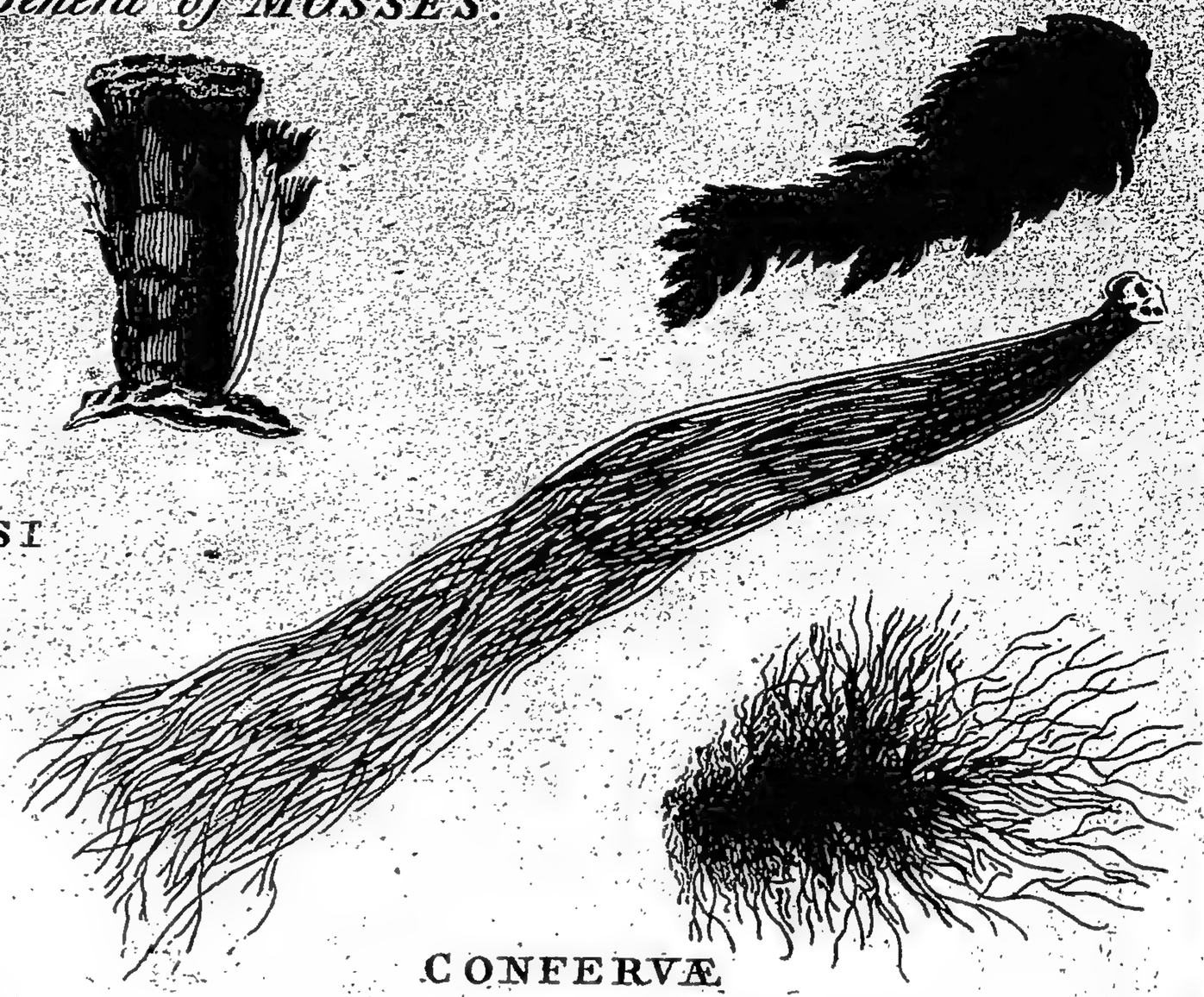
Thornton sculp.

Publish'd by Alex.r Hogg, at the Kings Arms, N.o 16 Paternoster Row.

BOTANY

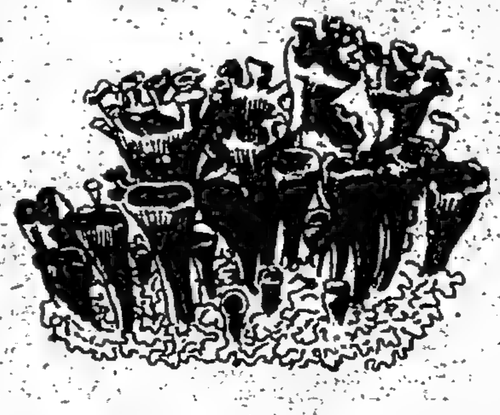
Genera of MOSSES.

BYSSI



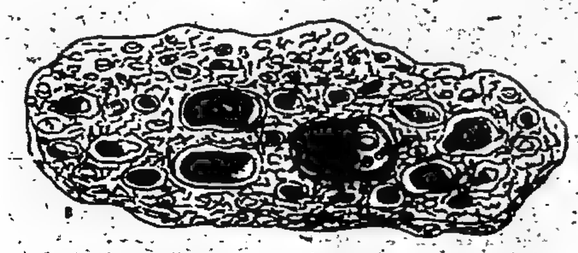
CONFERVÆ

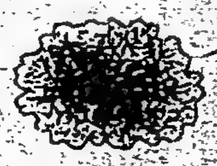
TREMELLÆ

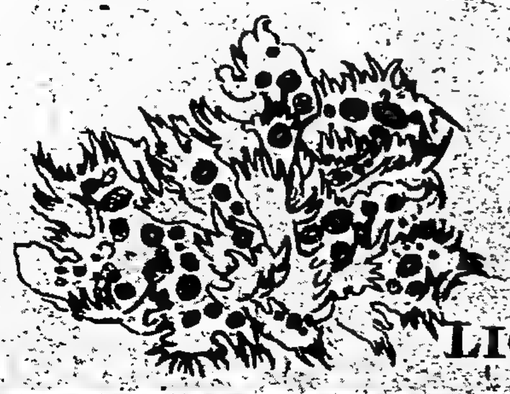


CORALLOIDES

USNEÆ







LICHENOIDES

MNIUM

SPHAGNUM

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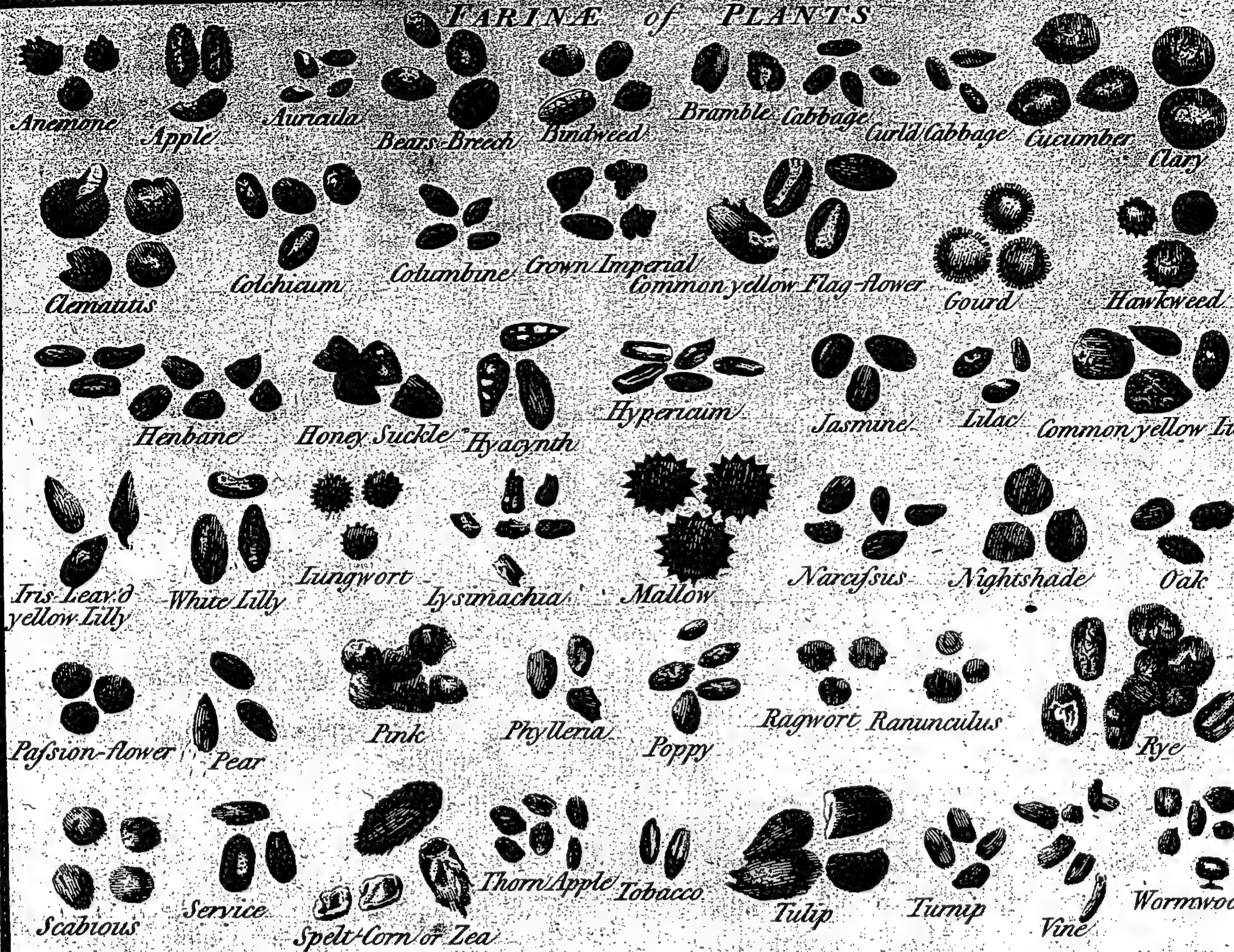
I.G.Wooding sculp.

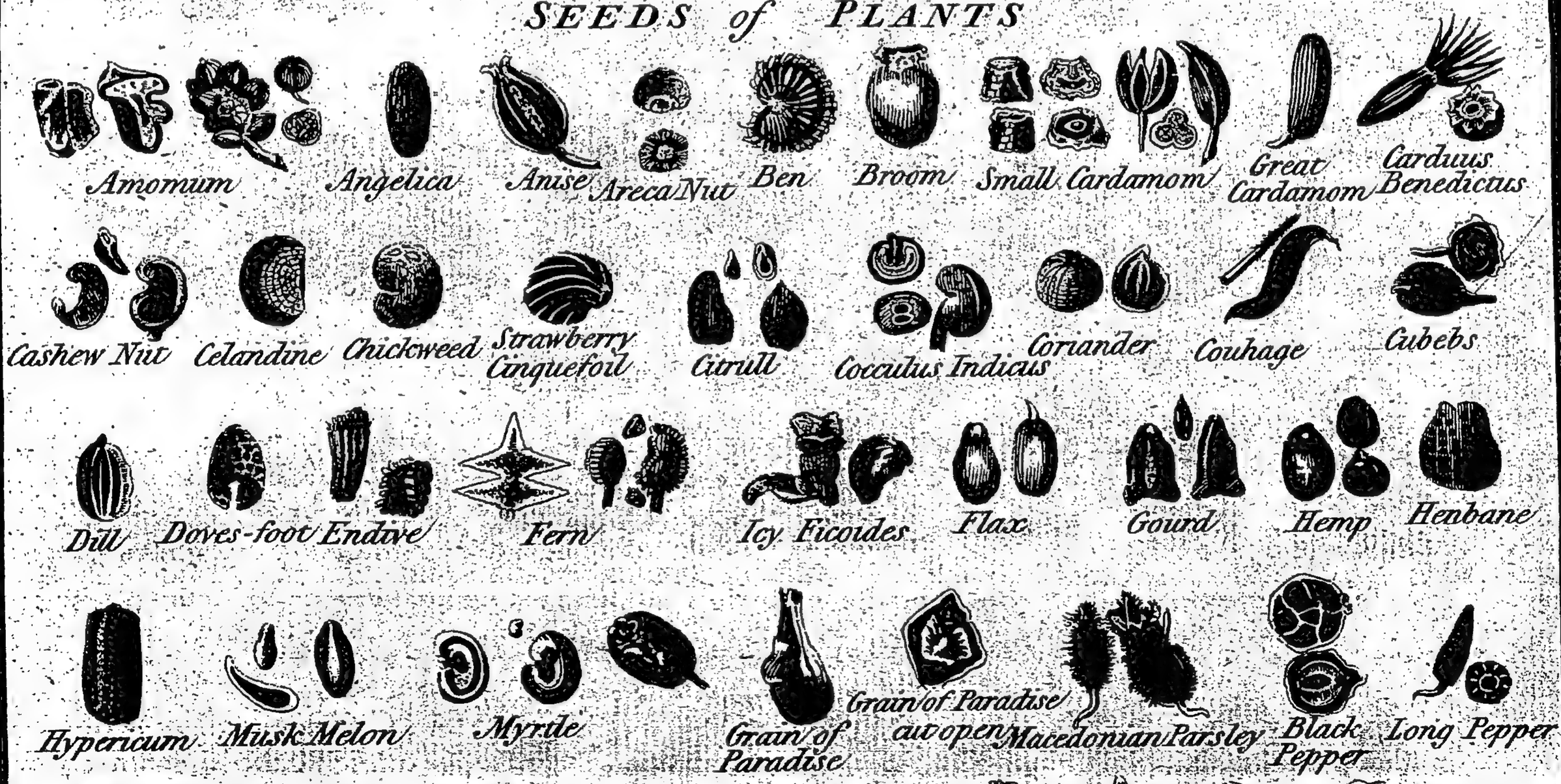
MICROSCOPICAL OBJECTS

Class II. Vegetable Subjects

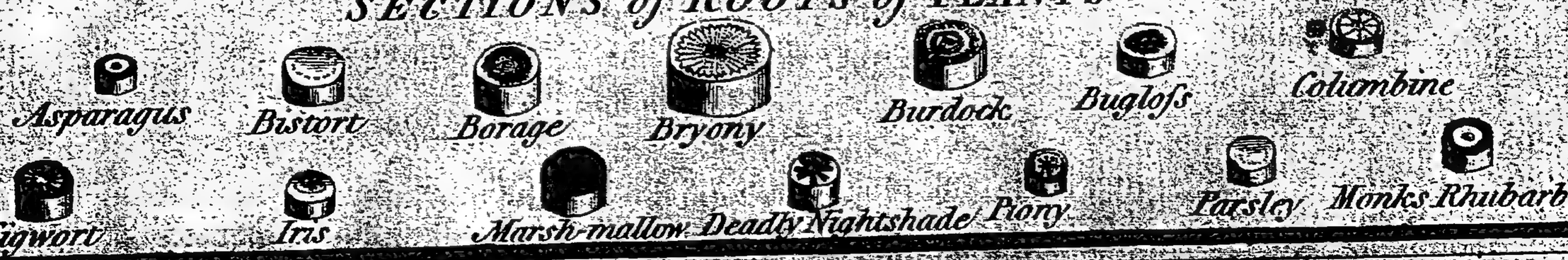
FARINÆ of PLANTS



SEEDS of PLANTS



SECTIONS of ROOTS of PLANTS



J.G.Wooding. sculp.

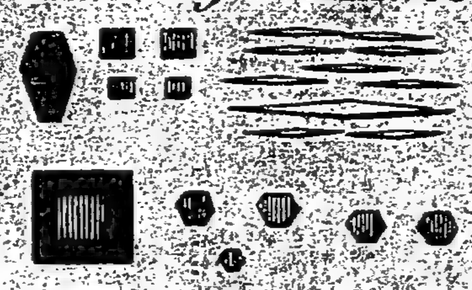
London, Published by Alex.r Hogg, at the Kings Arms, N.o 16, Paternoster Row.

MICROSCOPICAL OBJECTS

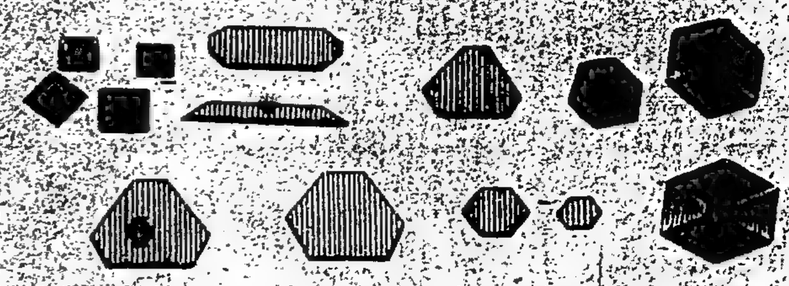
CRYSTALLIZATIONS

From the Fixed Salt *of* Carduus Benedictus

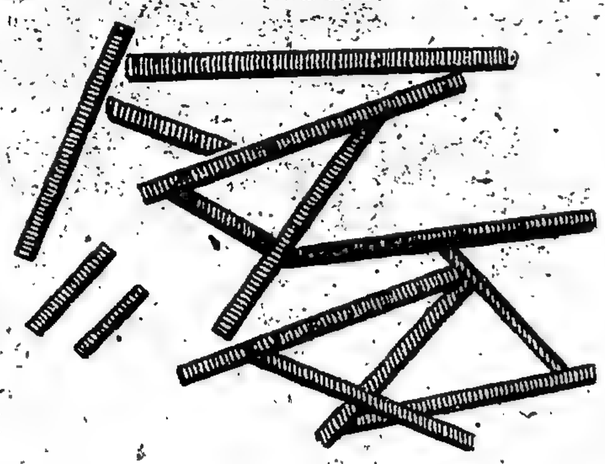
From Salt *of* Wormwood



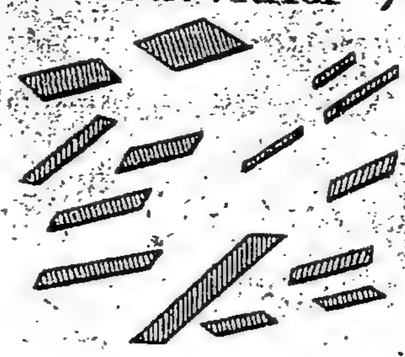
From Allum



From Nitre

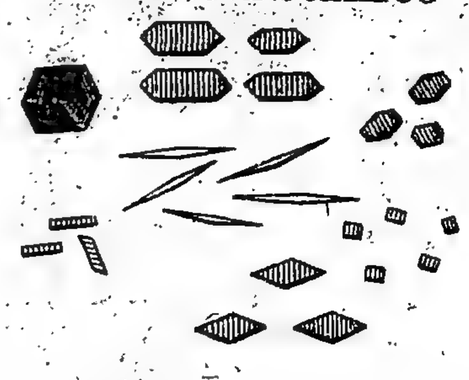


From Blue Vitriol

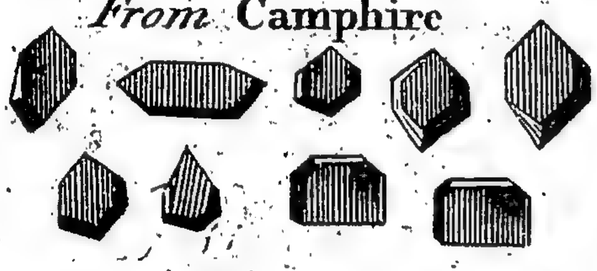


From Oil *of* Tartar *per deliquium*

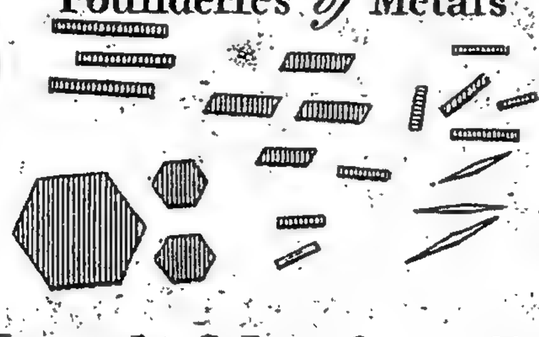
From Potaſhes



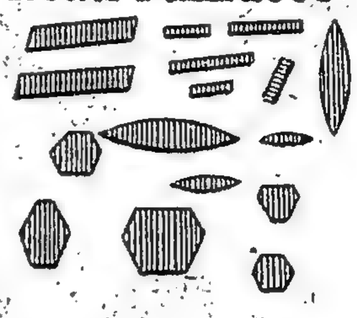
From Camphire



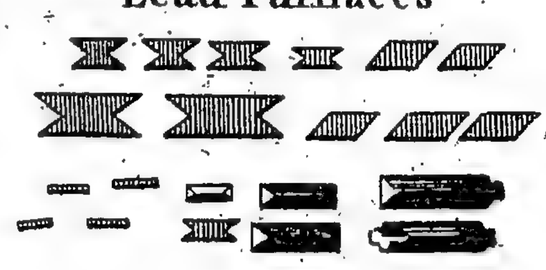
From the Aſhes *of* Founderies *of* Metals



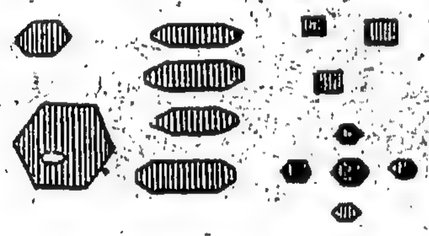
From the Aſhes *of* Lead Furnaces



From the Soot *of* Lead Furnaces

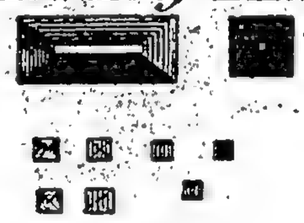


From the Salt *of* *Our* Glaſswort

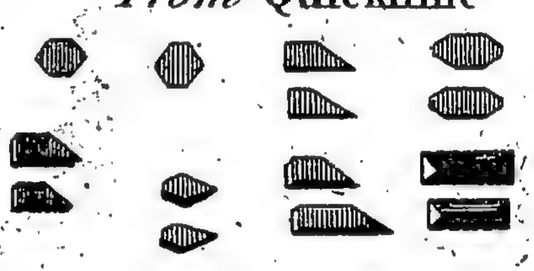


From the Salt *of* Glaſswort *of* Alicant

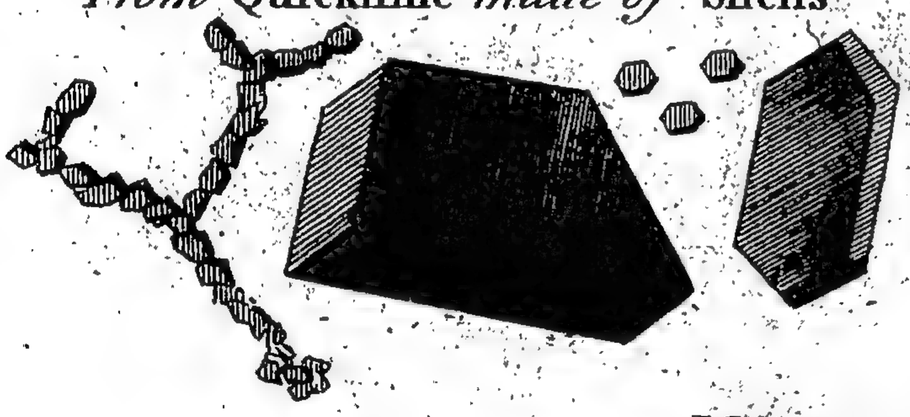
From the Salt *of* Glaſswort *of* Britany



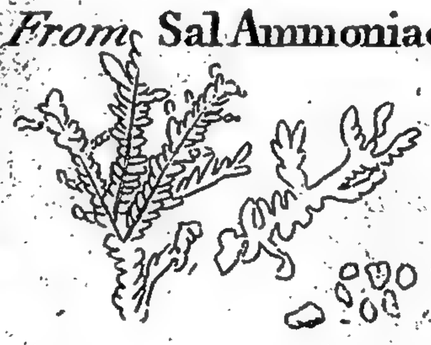
From Quicklime



From Quicklime *made of* Shells

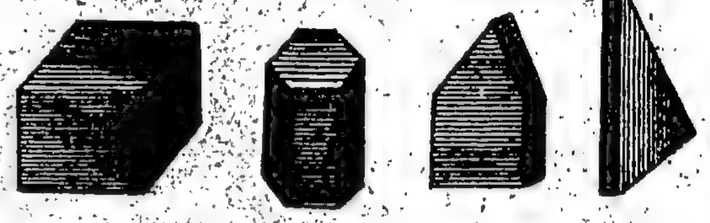


From Sal Ammoniac

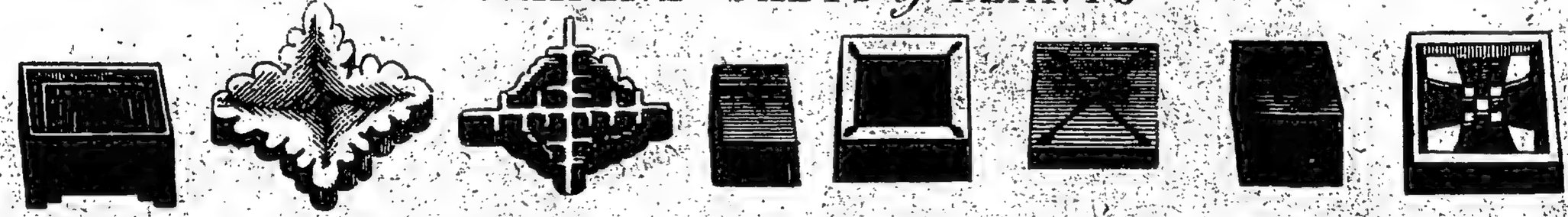


Conſtituent *SALTS of* Plants

Marine *Nitrous* *Alkaline* *Acid*



MARINE SALTS *of PLANTS*



Roſemary Garden Scurvygraſs Fern Blackthorn Wormwood

Eſſential SALTS *of PLANTS*

From Common Sugar Roſemary Wormwood Scurvygraſs

From SILVER diſſolved *in* Aqua-fortis

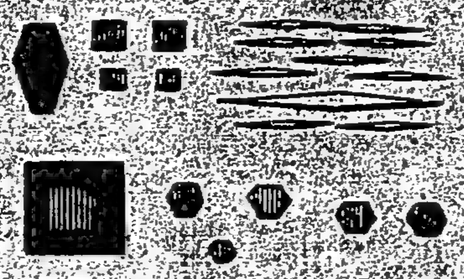
MICROSCOPIC OBJECTS

MICROSCOPICAL OBJECTS

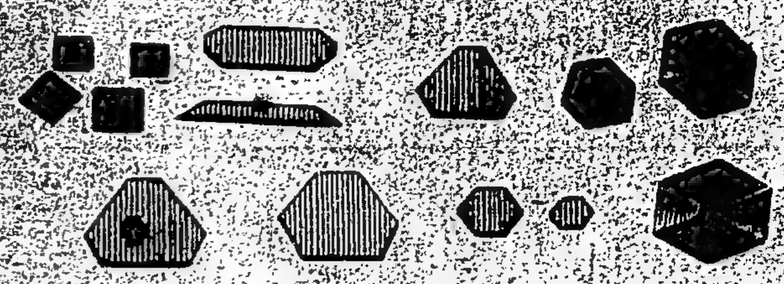
CRYSTALLIZATIONS

From the Fixed Salt *of* Carduus Benedictus

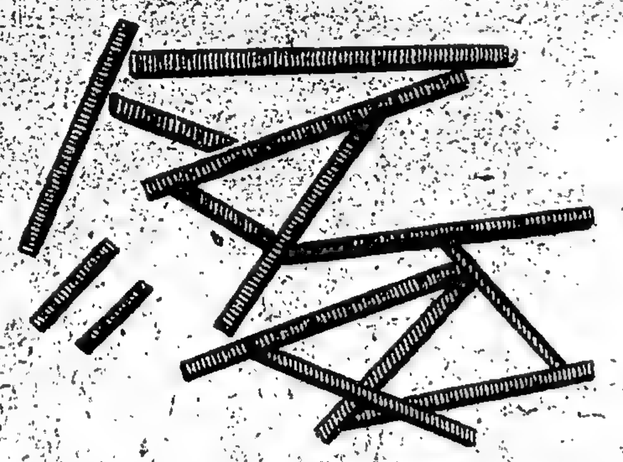
From Salt *of* Wormwood



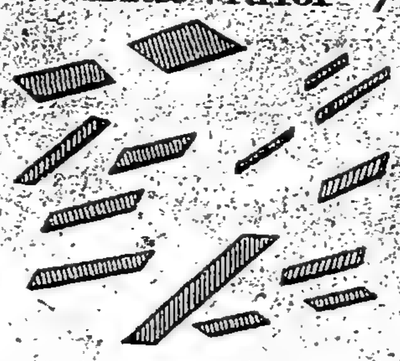
From Allum



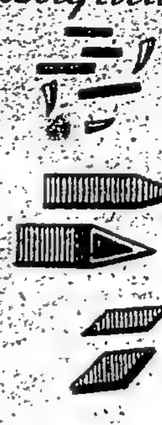
From Nitre



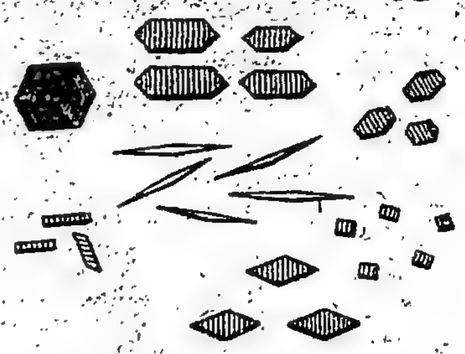
From Blue Vitriol



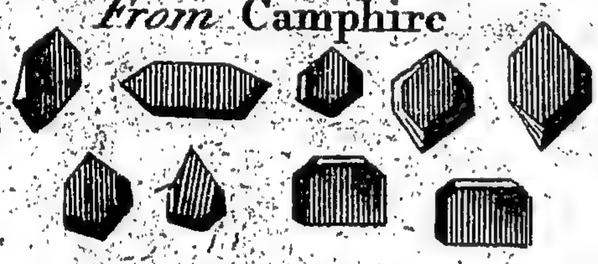
From Oil *of* Tartar *per deliquium*



From Potaſhes

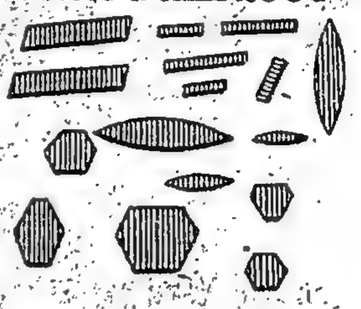


From Camphire

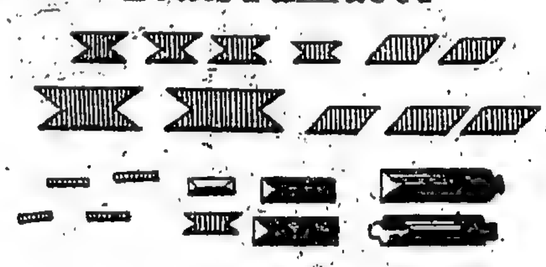


From the Aſhes *of* Founderies *of* Metals

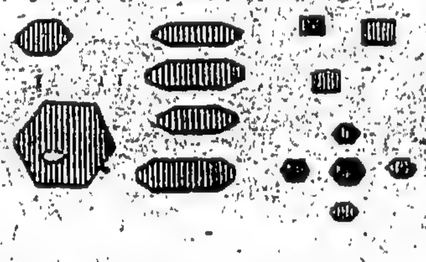
From the Aſhes *of* Lead Furnaces



From the Soot *of* Lead Furnaces



From the Salt *of* *Our* Glaſswort

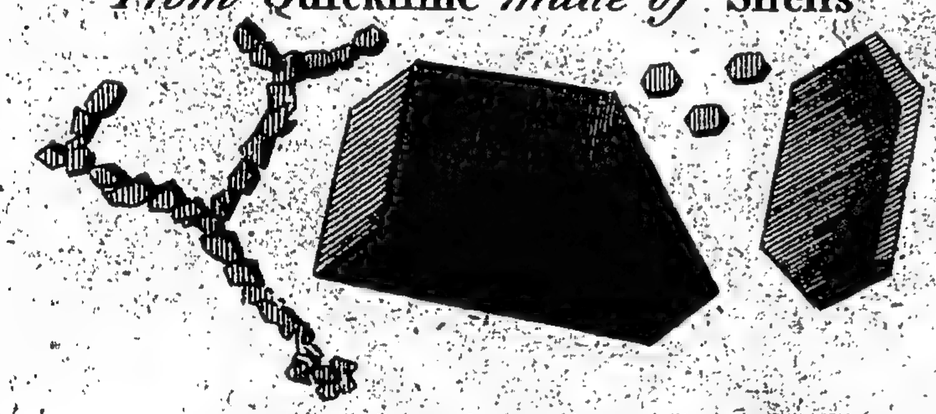


From the Salt *of* Glaſswort *of* Alicant

From the Salt *of* Glaſswort *of* Britany

From Quicklime

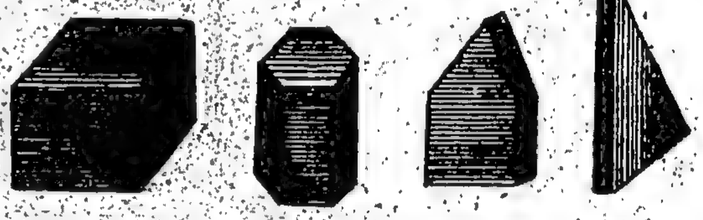
From Quicklime *made of* Shells



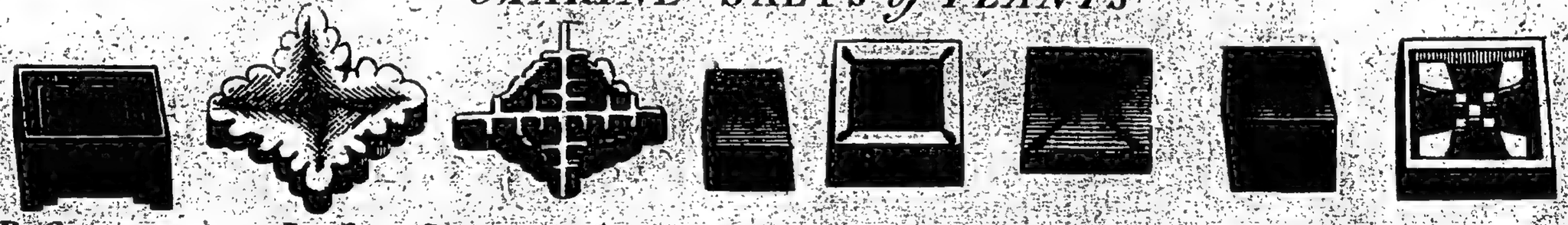
From Sal Ammoniac

Conſtituent *SALTS of* Plants

Marine *Nitrous* *Alkaline* *Acid*

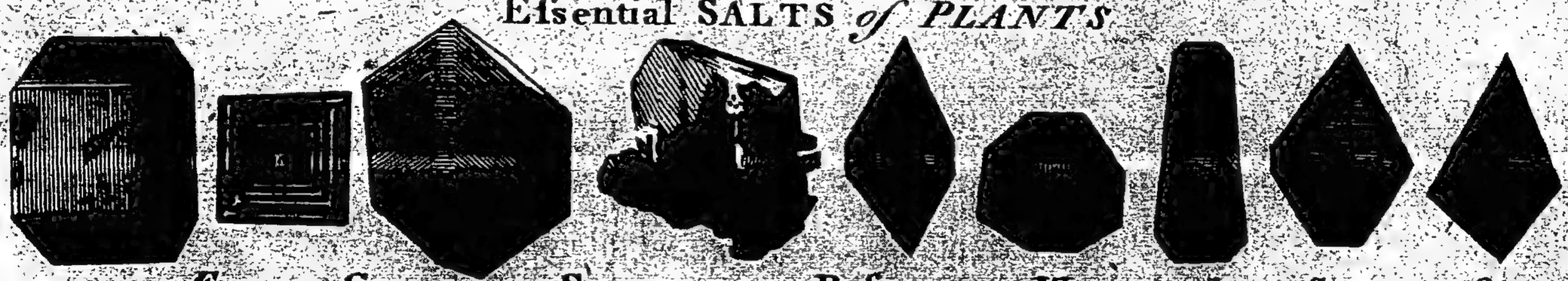


MARINE SALTS *of PLANTS*



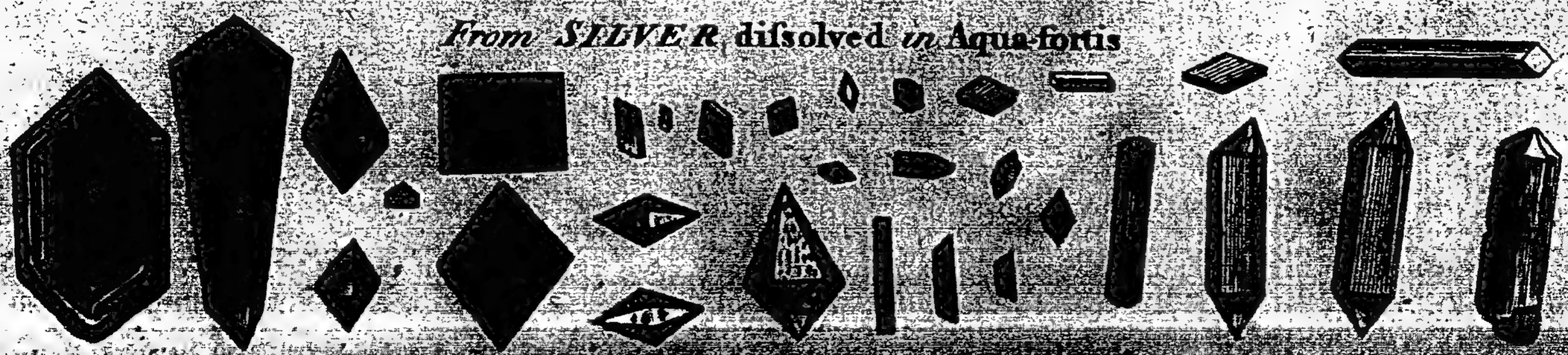
Roſemary Garden Scurvygraſs Fern Blackthorn Wormwood

Eſſential SALTS *of PLANTS*



From Common Sugar Roſemary Wormwood Scurvygraſs

From SILVER diſſolved *in* Aqua-fortis

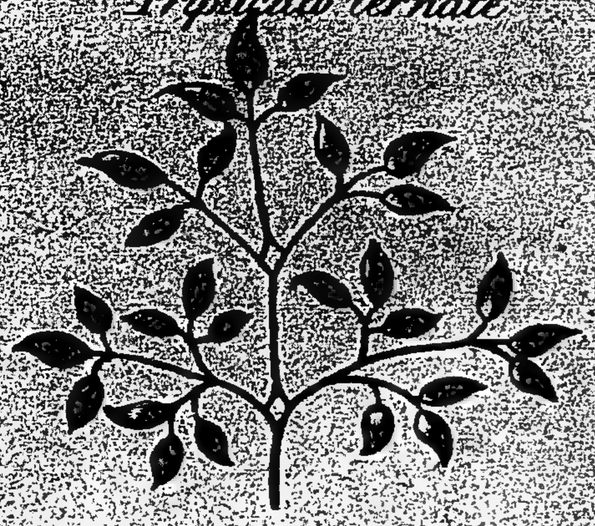


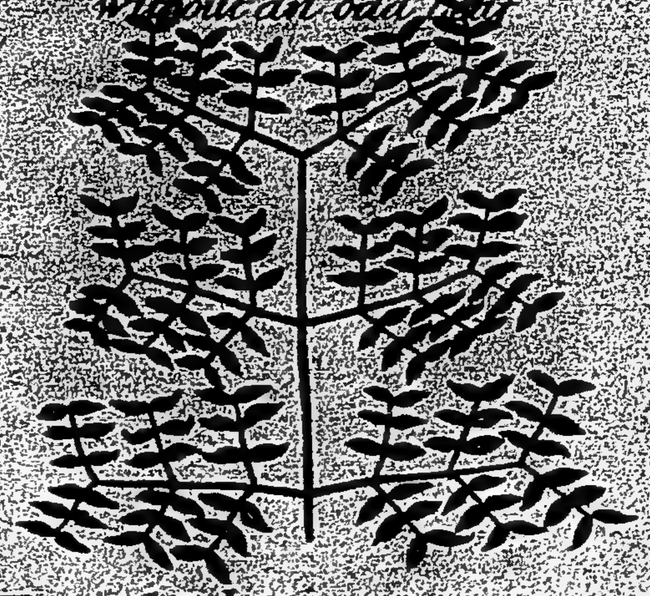
MICROSCOPIC OBJECTS

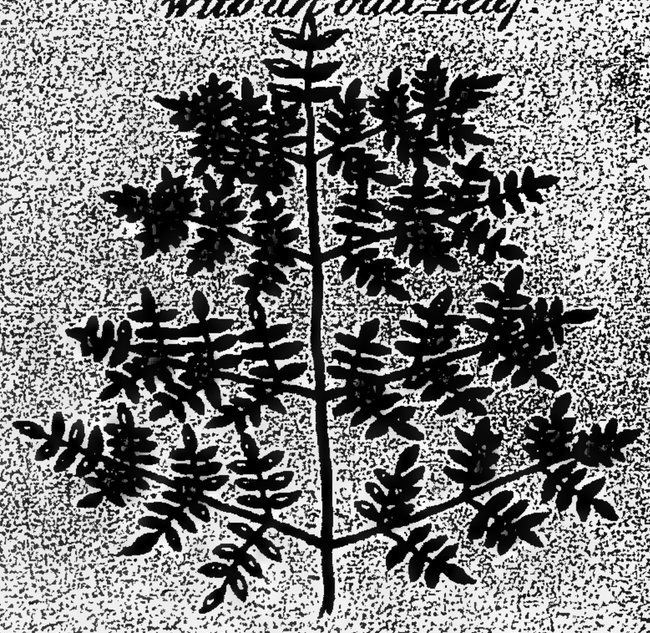
BOTANY.

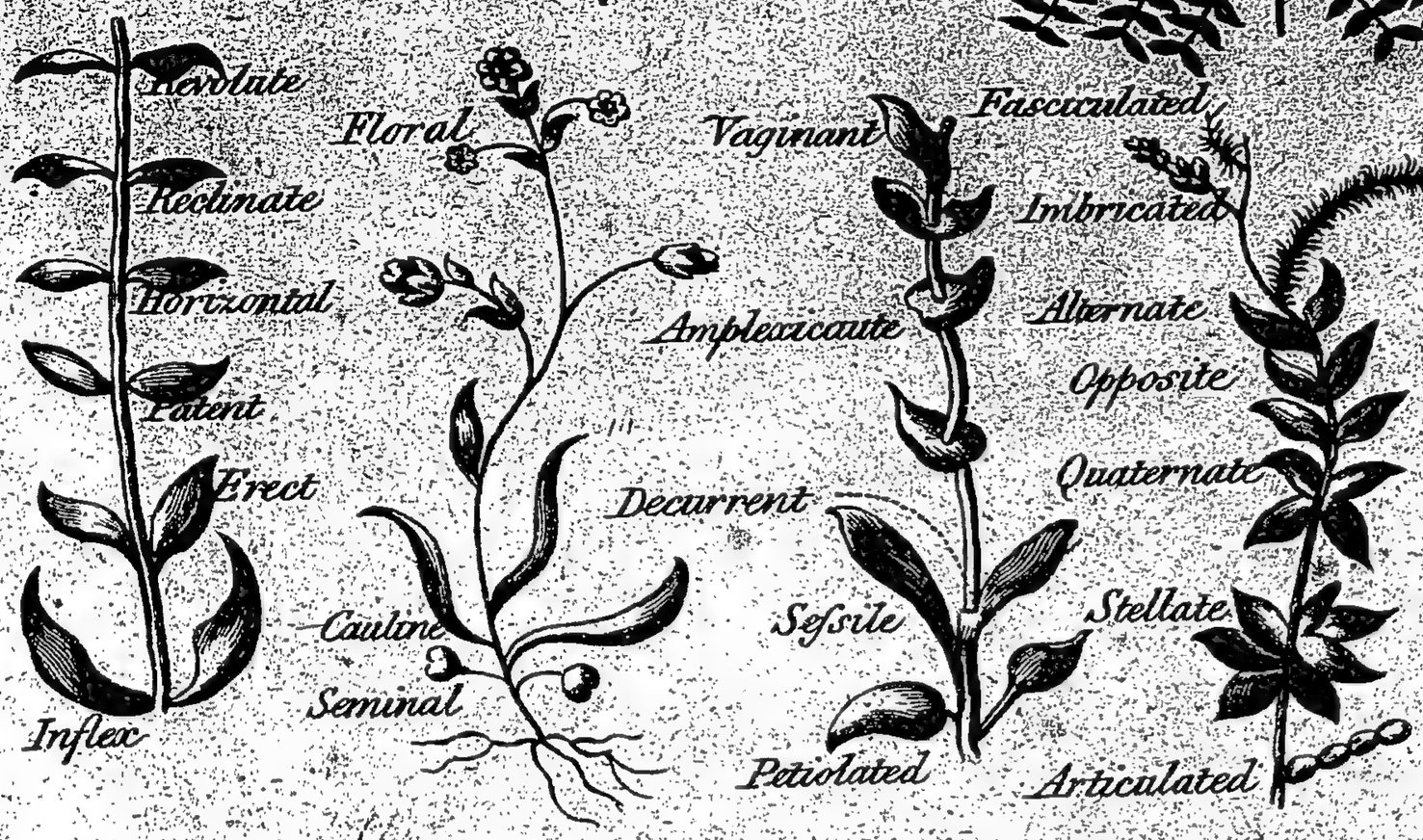
LEAVES

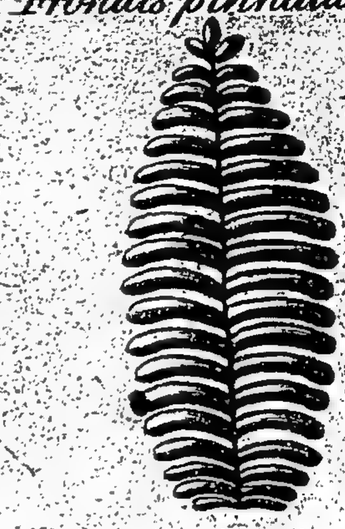

Duplicato pinnated.


Triplicato ternate


Triplicato pinnated without an odd Leaf


Triplicato pinnated with an odd Leaf.




Frondis pinnatus

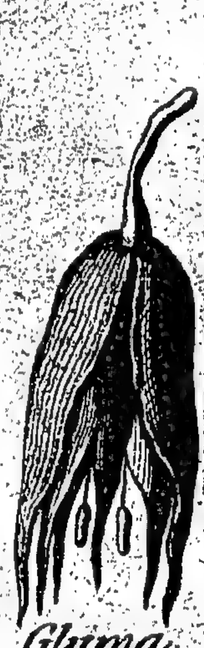

Frondis articulatus

PARTS of CUPS FLOWERS and FRUITS.


Involucrum

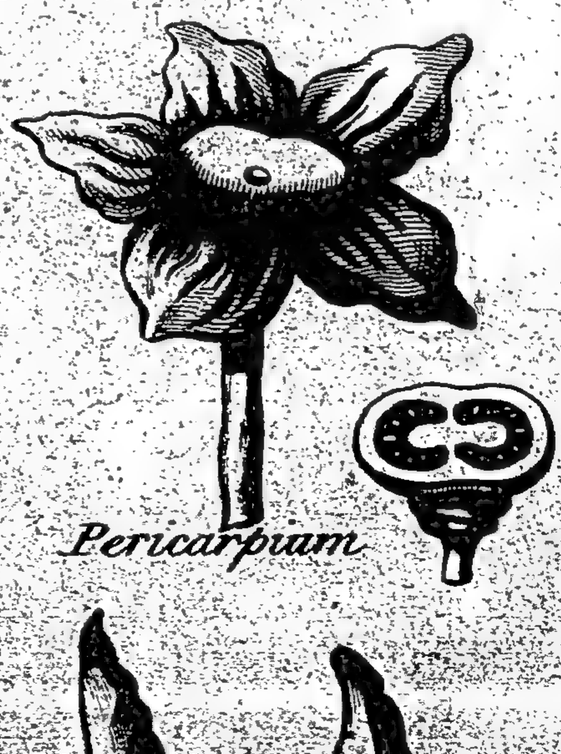

Spathæ

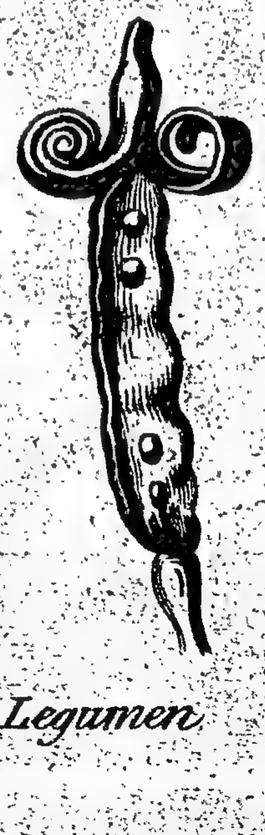

Spathæ


Gluma

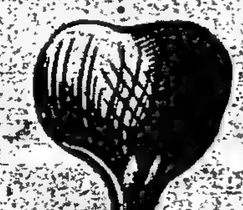

Amenta


Nectaria


Pericarpium


Legumen

Bractea


Petalum

Limbus
Tubus

Siliqua

Corollula ligulata

Corollula tubulata

Nectarium

Papposus and Coronated Seeds.

MICROSCOPICAL OBJECTS

Clafs I. Animal Subjects.

Circulation *of the* BLOOD

In the Membrane of a Frogs Foot.

In the Tail of a small Fish

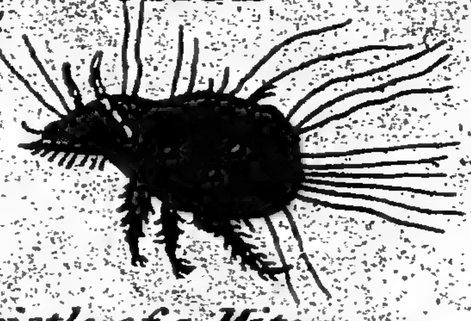
CONNAUGHT WORM

FLEA

LOUSE

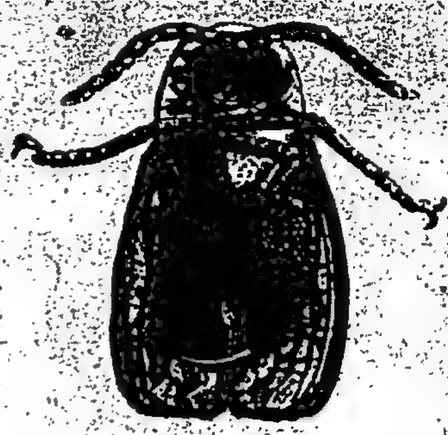
ITCH ANIMAL

MITE



Bristle of a Mite

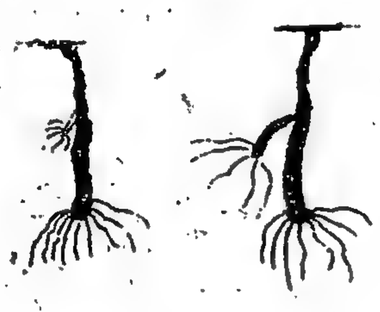
FLYING CICINDELA

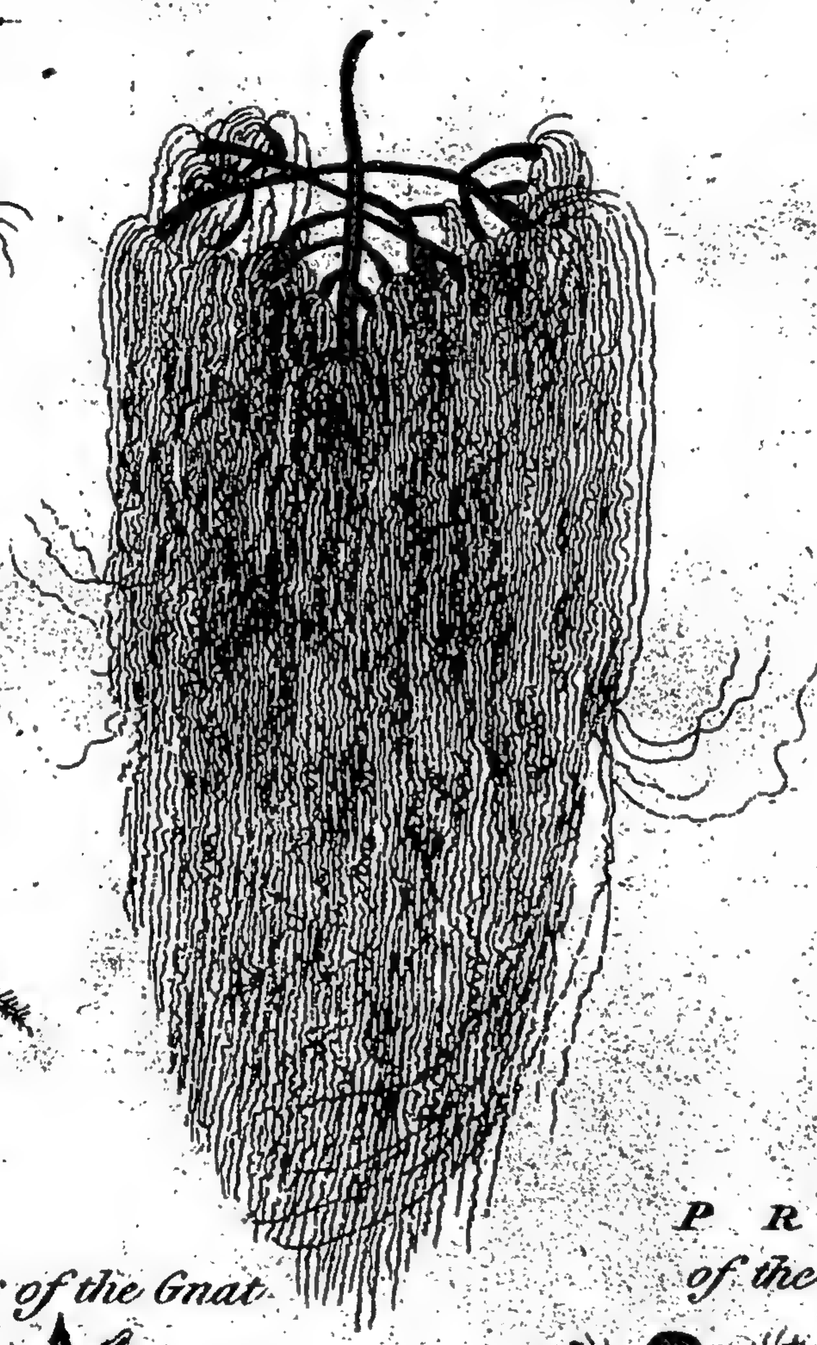


SEA SCOLOPENDRA

BELL POLYPE

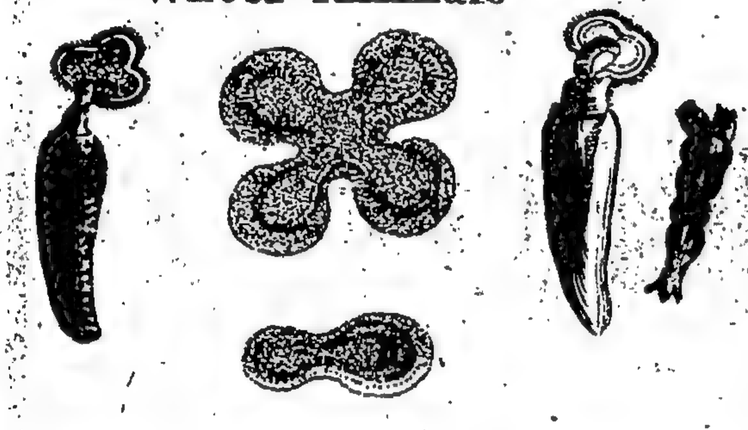
P O L Y P E





PULEX ARBORESCENS

Wheel Animals



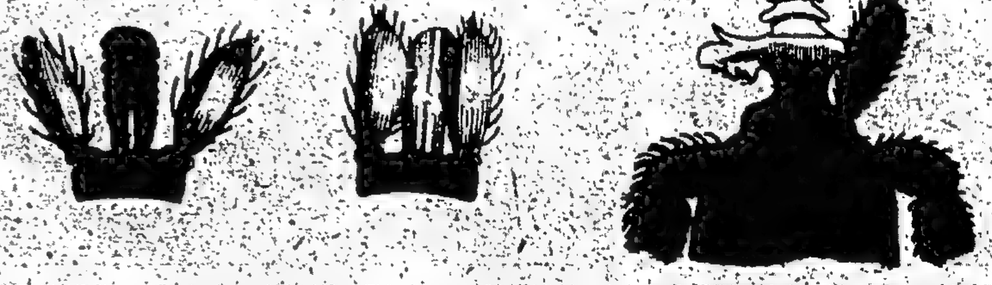
Crufted Water Animalcules

Tail of D°

Darts of the Gnat

P R O B O S C I S

of the Dog Tick *of the little Black Tick*

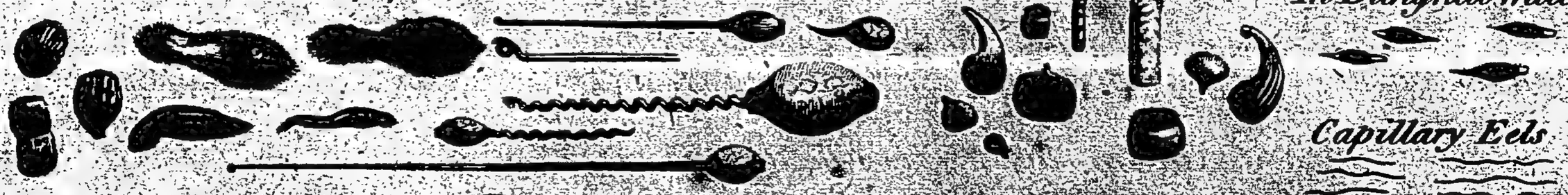


A N I M A L C U L E S

In Pepper Water

In Hay Water

In Dunghill Water



Capillary Eels

In Male Seed

Men

Rams

Frogs

Cocks

Stags

Dogs

Rabbets

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BOTANY.

Tournefort's System Genera of Plants.

CLASS XIV. Plants with Radiated Flowers.

Aster. Bupsthalgo. Asteriscus. Xeranthemum. Carlina.

CLASS XV. Plants with Apetalous or Staminous Flowers.

Bistorta. Milium. Cyperus. Ricinus. Equisetum.

CLASS XVI. Plants which have Seeds but seem to have no Flowers.

Lonchitis. Trichomanes. Ruta Muraria. Adiantum.

CLASS XVII. Plants which seem to have neither Flowers nor Seeds.

Fungus. Fucus. Acetabulum. Corallina. Corallium. Madrepora. Lithophyton.

CLASS XVIII. Trees and Shrubs with Apetalous Flowers.

Buxus. Terebinthus. Fraxinus.

CLASS XIX. Trees and Shrubs with Amentaceous Flowers.

Ilex. Fagus. Cupressus. Platanus. Salix. Populus.

CLASS XX. Trees and Shrubs with Monopetalous Flowers.

Jasminum. Styrax. Nerion. Opulus. Xylosteon.

CLASS XXI. Trees and Shrubs with Rosaceous Flowers.

Hippocastanum. Rubus. Staphylodendron. Senna. Mespilus.

CLASS XXII. Trees and Shrubs with Papilionaceous Flowers.

Genista. Siliquastrum. Anagyris. Pseudoacacia. Cytisus.

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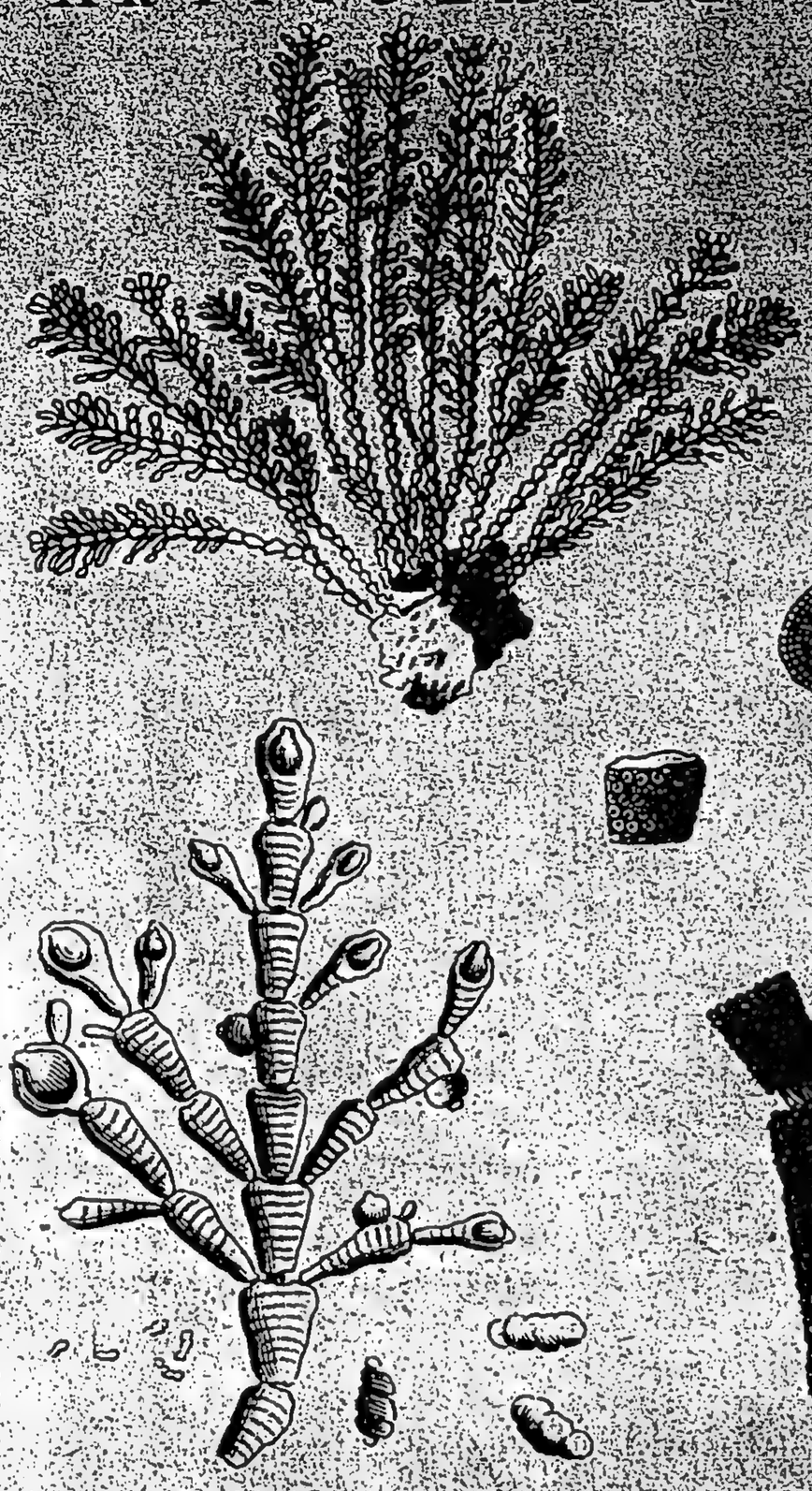
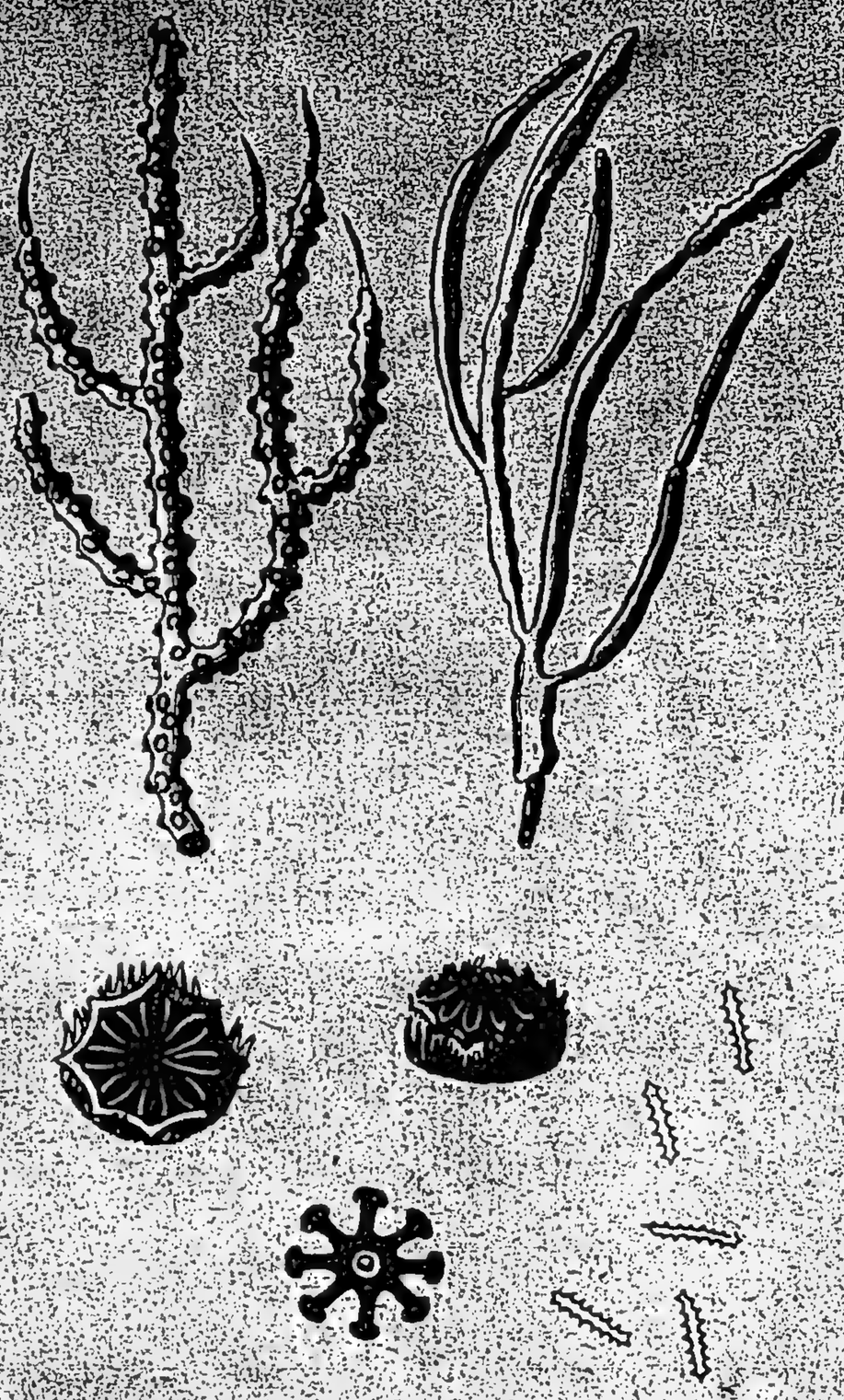
Lee Mentor sculp.

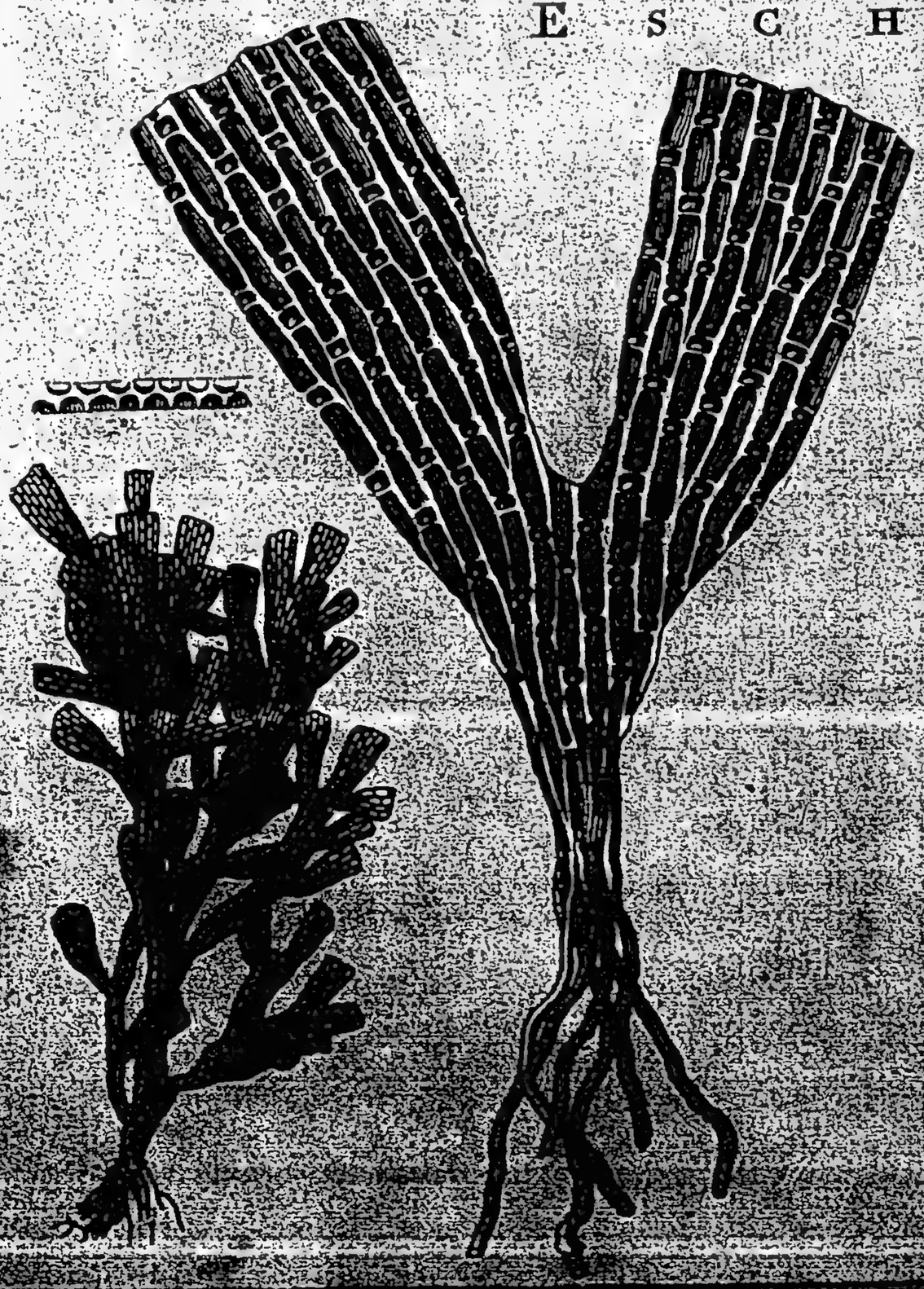
ARTICULATED

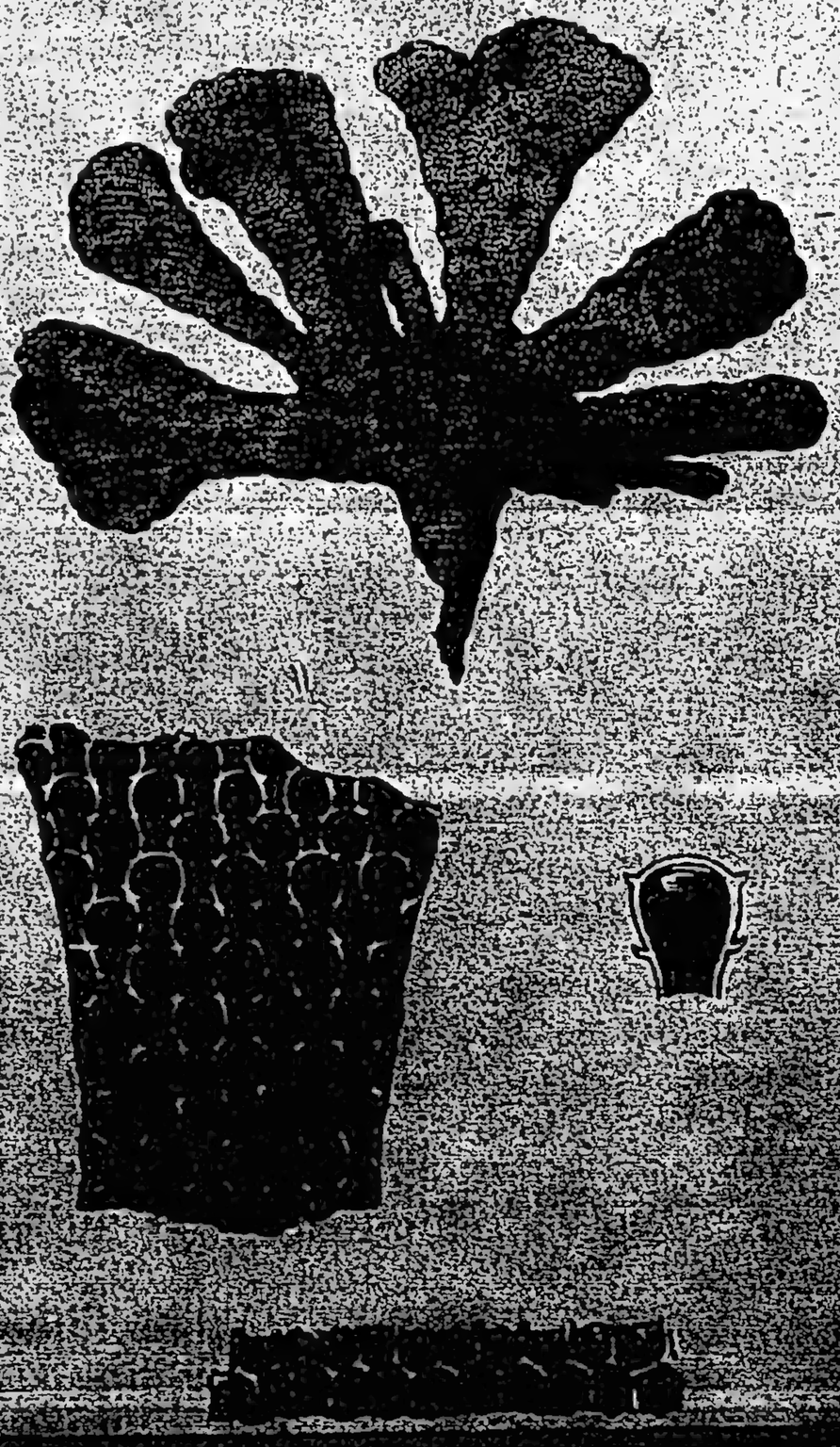


KERATOPHYTA



ESCHARA





this, there are others of equal importance to the well-being of plants and fruits; the first is, that of the foot-ſtalks and leaves nouriſhing, and preparing the buds of the future ſhoots, which are always formed at the baſe of thoſe foot-ſtalks, and during the continuance of the leaves in perfect health, theſe buds increaſe in their magnitude; and, in the deciduous trees, are brought to maturity before the foot-ſtalks ſeparate from the buds in autumn; but if by accident the leaves are blighted, or if the entire ſurface of the leaves are cut off, and the foot-ſtalks are left remaining, the buds will decay for want of that proper nouriſhment which is conveyed to them from the leaves; ſo that whenever trees are diveſted of their leaves, or thoſe leaves are cut, or otherwiſe impaired, though it may in either caſe happen when the buds may be nearly formed, yet if it is before the foat-ſtalks ſeparate naturally from their branches, the future ſhoots will be weakened in proportion to the time when this is done; therefore from all the experiments which have been made in order to know how ſerviceable the leaves of trees and plants are to their well-being, it has been found, that when the plants have been diveſted of their leaves, or their leaves have been eaten or cut, during their growth, the plants have been remarkably weakened thereby. This ſhould teach us not to pull or cut off the leaves of trees, or plants, on any account while they retain their verdure, and are in health; and this ſhews how abſurd that common practice is, of feeding down wheat in the winter and ſpring with ſheep; for by ſo doing, the ſtalks are rendered very weak, and the ears are in proportion ſhorter; nor are the grains of corn ſo plump and well nouriſhed, as that which is not fed down upon the ſame ground: this is a fact which we can aſſert from many years experience. It is very evident, that graſs which is often mowed, the blades will be rendered finer in proportion to the frequency of mowing it, yet the ſpecies of graſs is the ſame with that on the richeſt paſtures; ſo that although this may be a deſirable thing for lawns, &c. in gardens, yet where regard is had to the produce, this ſhould be avoided.

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Sea-Locuſt or Prawn, named in the plate of cruſtateous animals, Locuſta Mariha Indica, has two large feelers placed before the eyes.

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Of TURBINATED SHELL-FISH.

They are ſomewhat in the ſhape of a top, and are ſurrounded with ſpiral furrows, much like a ſcrew, being wide at the mouth, and terminate by degrees in a point. Within they are all nearly alike with regard to their ſurface, which is exceeding ſmooth; of theſe kinds are—

The Nautilus, or Sailor; one of which is a ſmall ſort, and comes out of its ſhell; but the other keeps to its ſhell like a ſnail, or at leaſt ſeldom comes out of it.

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ARTICULATED

KERATOPHYTA

ESCHARA

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Pearl Shelled Nautilus; ſo called from having a ſhell exceeding bright on the inſide.

Little Thick Nautilus, is of a roundiſh form, and rarely exceeds an inch and a half in diameter.

Thin

Thin Eared Nautilus has a very beautiful ſhell, which grows to ten inches in length, and is exceeding thin.

Paper Nautilus, ſo called from the thinneſs of its ſhell, is often met with twelve inches long, and is compreſſed on the ſides.

Thin Nautilus without Ears, is ſmaller than the former kind, for it is but five inches long, and three or four deep.

Purpura is of the ſize of an egg, and ſometimes bigger. There are ſeveral ſorts of them, as—the yellow Long-ſnouted, with long crooked ſpines—The variegated Long-ſnouted, nearly of an oval ſhape—The Short-ſnouted, about two inches long, and its diameter, with the ſpines and thorns, is an inch and a half—and that with three rows of ſpines is about three inches long, including the ſpines, and as much in diameter.

Trumpet Shell, called Buccinum, from its imaginary likeneſs to a trumpet or horn.—One of the iſland of Goree, which is ſeldom above half an inch long, and its breadth is leſs by one half.—Another of Senegal: It is compoſed of ten turns or ſpires; which are all ſmooth, poliſhed, and flatted, except the firſt; but they are not very diſtinct from each other.

The Hedge-Hog Murex is three inches and a half long, and about two and a half broad, where thickeſt.—One with a ſmooth clavicle, is two inches and a half long, and near two in diameter where broadeſt.

Ribbed Muſic Shell. Its body is ſhort, and there are ſeveral low ribs at ſome diſtance from each other. It is a native of the Eaſt Indies.

Gold-mouthed Cochlia or Snail. This is round, and edged on the circumference with a narrow lip. It is common in America.

The Snail has numerous varieties, as the Hedge-Hog—The Smooth Ribband—The Watery—The Smooth Brown—The Three Ribbed—The Toothed—The Banded—The Prickly—The Clouded—The Conical Tuberculated—The French-Horn.

Others of different kinds of Shell-Fiſh are noticed by authors; the diſtinct names of them will be found in the plates; to enlarge upon which, by a particular deſcription, would extend this work to a tireſome length, and very far beyond our preſcribed limits.

Of TURBINATED SHELLS.

Theſe are of a ſimple kind, conſiſting of one piece, and of a long ſlender make, always terminating in a very long fine point. The mouth is narroweſt towards the baſe, and has a ſort of an ear. They are of different ſhapes, and in general they are called Screw-Shells.

The Thick Turbo, or Screw-Shell, has an oval mouth, and conſiſts of about fourteen turns, of which that next the mouth is the largeſt, from which they gradually diminiſh to the end which is pointed.

The Needle, or Slender Screw-Shell. This has roundiſh ſpires, and it becomes gradually ſmaller from the mouth to the other end, where it terminates in a point. It conſiſts of ſixteen ſpiral turns, which are all bellied, riſing very high in the middle. It has only a notch, where the ear is placed, and the whole ſurface is perfectly ſmooth. The colour is white, variegated with yellow.

The Turbo, or Screw-Shell, with bellied ſpires and elevated ribs, is an inch and a half in length, and the largeſt turn a little more than the third of an inch in diameter. The colour is white, and the mouth round and pretty large, with a thick lip. It is common on the ſhores of Barbadoes.

The Conical Turbo, or Screw-Shell, with plain ſtreaked and numerous ſpires, is by ſome called the Teleſcope Shell.

The Slender Turbo, or Screw-Shell, with ſpiral lines on the turns, is four or five inches long, and ſcarce half an inch thick where thickeſt. The colour of the ſhell is yellow, unleſs it has lain long on the ſhore. It is found on the ſhores of the American iſlands, as well as in the Eaſt Indies.

The Turbo, or Screw-Shell, with diſtant and prominent ſpires, is about five inches long, and the diameter of the ſpire next the head, is about three quarters of an inch. The colour is whitiſh, with a tincture of yellow and red, and it is brought from the Eaſt and Weſt Indies.

The Warty Turbo, or Screw-Shell, with a broad depreſſed mouth, called by ſome the Caterpillar-Shell, is about two inches and a half long, and near three quarters of an inch in diameter next the mouth. The ſhell in general is pale, variegated with a darker colour; but the protuberances are blueiſh. It is brought from China.

The Turbo, or Screw-Shell, with a long wide mouth, is three inches long, and of the thickneſs of a man's little finger. The colour is browniſh, variegated with a deeper brown, and a reddiſh tawny. The ſurface is ſmooth, only there are a few tubercles on the ſecond turn. It is brought from the Eaſt Indies.

The Oblong Mouthed Turbo, or Screw-Shell, with ſpires jagged at the edges, is about two inches long, and the third of an inch thick at the baſe. The colour is of a faint brown, a little variegated with tawny and reddiſh, and regular rows of little black dots. It is found in America, and ſome parts of Europe.

The Thick-Eared Turbo, or Screw-Shell, with turns deeply jagged at the edges, is three inches long, and in diameter, where thickeſt, an inch.

The Screw Shell of Senegal is like a cone rounded at the baſe, and grows gradually ſmaller to the top, where it terminates in a very fine point.

Of WREATHED SHELLS.

The Voluta are of one piece, and of a figure nearly conical, but ſhort, the clavicle being commonly depreſſed; and the mouth long, perpendicular, and narrow.

The Jamar, is a Voluta of Senegal, very thick, and nearly of a conical ſhape. A membranous ſkin of a reddiſh colour ſurrounds the whole ſurface of the ſhell, and when this is taken off, it appears of a fine poliſh, and beautifully variegated with different colours. The ground is white, red, yellow, or brown, marbled with ſpots without any regularity, and ſometimes encircled with pointed ſtreaks. This ſhell is highly valued by the curious, who have given it different names, according to the varieties.

The Admiral Shell, or Voluta, with a broad yellow band, and a pointed line thereon, is an uncommon and very beautiful ſhell, bearing a great price. It is about two inches long, and near an inch in diameter towards the head, from whence, to the extremity of the mouth, it gradually decreaſes in ſize, ſo as to form a ſort of a cone, with an obtuſe point. The clavicle alſo diminiſhes in diameter, and terminates in a blunt point. The ground colour of the ſhell is of a beautiful yellow, but ſo variegated, that it does not take up above one third of the ſurface. There is a circle or ring of this colour at the head, of about the breadth of a ſtraw, and below it there are three broad belts or rings finely variegated. The loweſt of the three are broader than the others, and ſeparated by five yellow lines. Under the belts the fine yellow again

makes

PATELLÆ or LIMPETS

AURES MARINÆ
or EAR-SHELLS

DENTALIA

COCHLEÆ ORE ROTUNDO

COCHLEÆ ORE SEMI ROTUNDO

COCHLEÆ ORE DEPRESSO

NAUTILUS

BUCCINA or TRUMPET-SHELLS

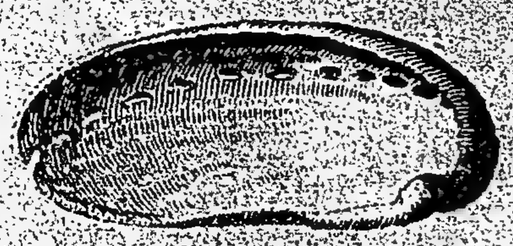
VOLUTÆ

FLAMBEAU ADMIRAL VICE ADMIRAL BUTTER FLY

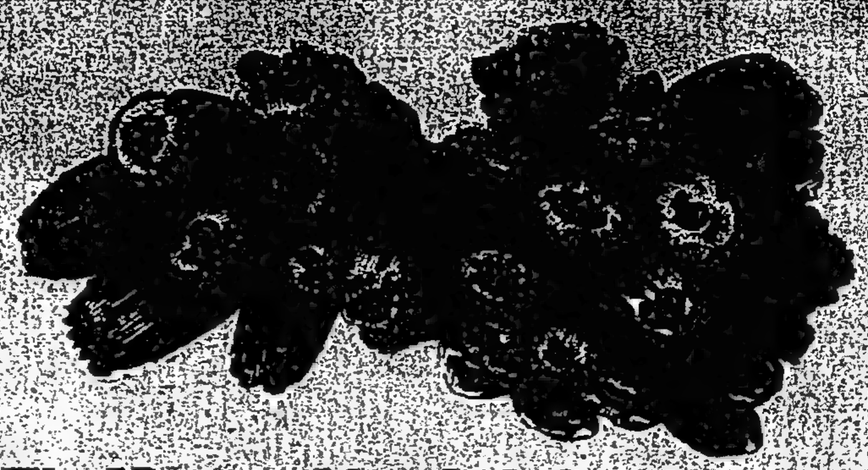
GYLINDRI

TURBINES

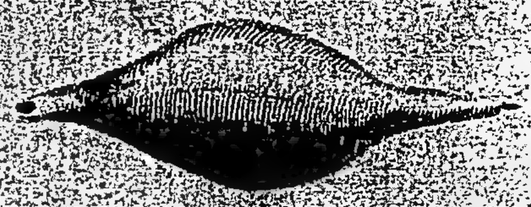
SHELL FISH



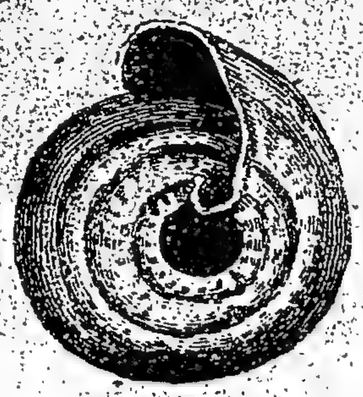
The Long Ear Shell



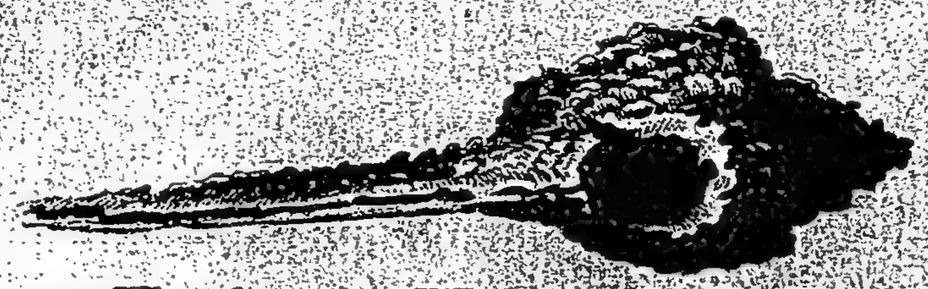
The Narrow Mouth'd Grey Balanus



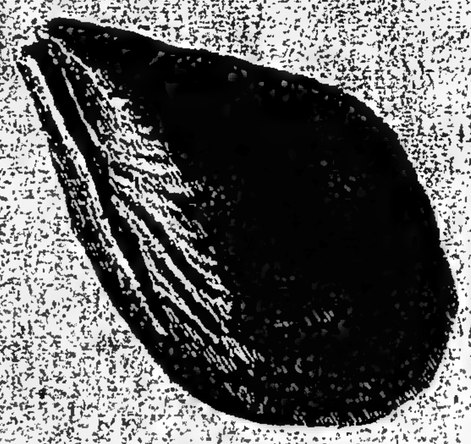
The Boat Porcellane



The Cornu Ammonis Snail

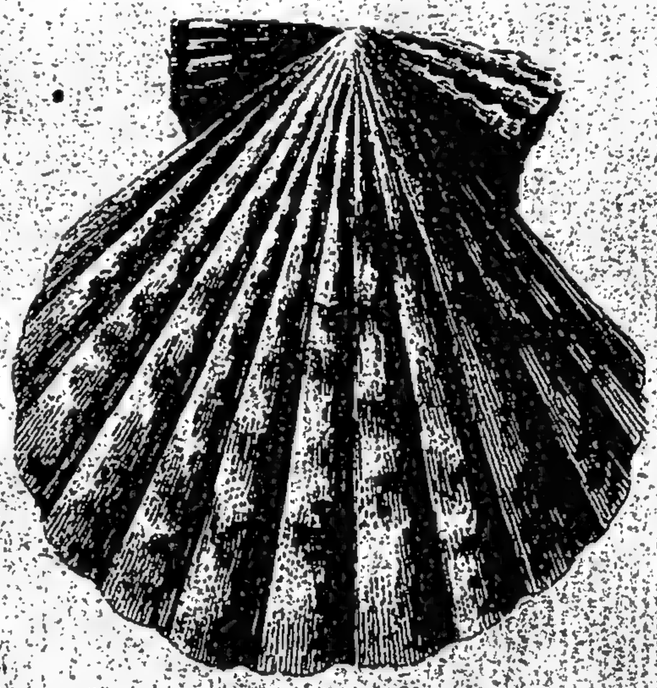


The Common Woodcock Shell



The Magellanick Muſcle

The Pointed-headed Porcellane

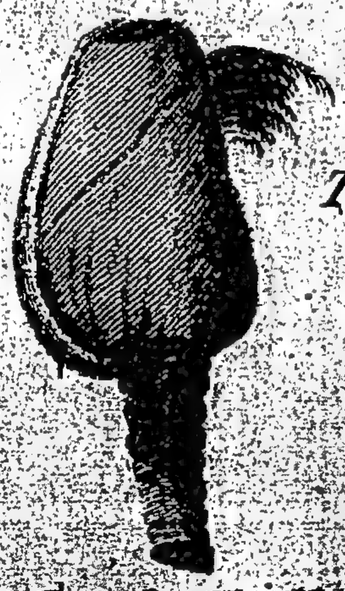


The large Rib'd Scallop

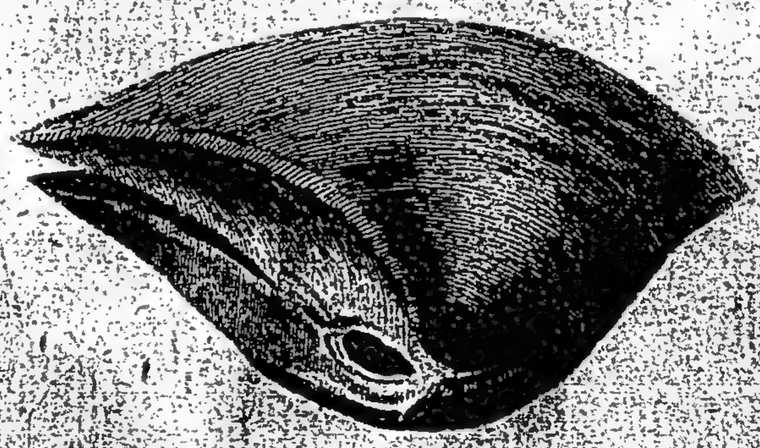
The Pointed Murex

The Agate Muſcle

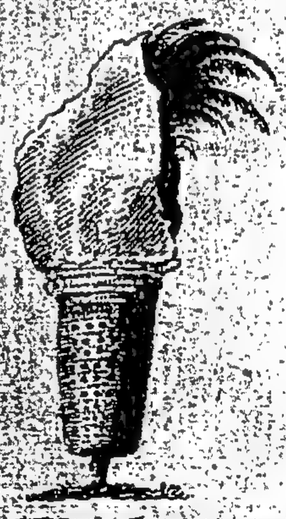
The high Lip'd Dolium.



The Goose Shell



The Violet and White Chama



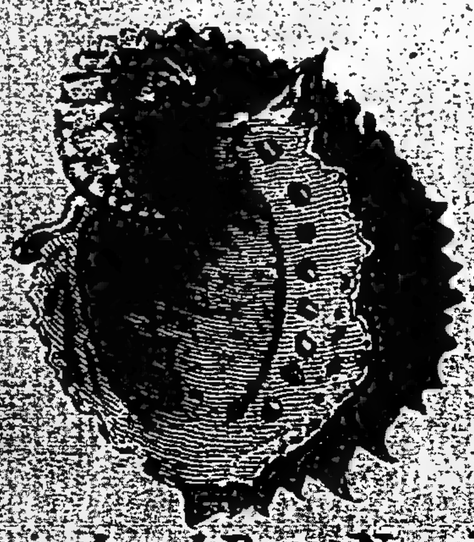
The Thick stem'd Goose Shell

The prickly Snail

Stomatius

The Yellow Zgrid Porcellane

The Exotic Heart Cockle



The Auriculated Paper Nautilus

London, Published by Wm. Bagg, at the Kings Arms, N°16, Paternoster Row.

Page sculp.

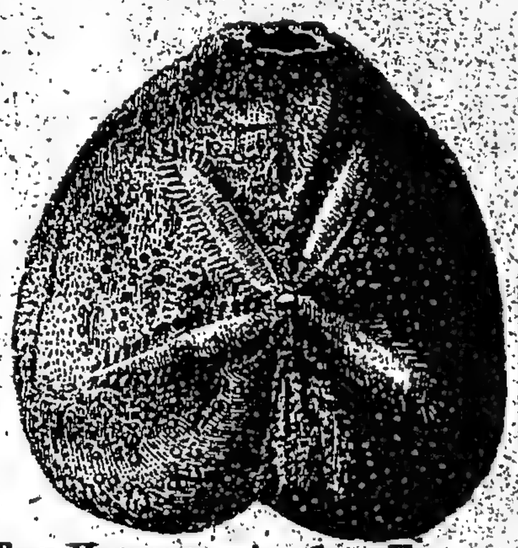
SHELL FISH.

THE RIBB'D MUSICK SHELL

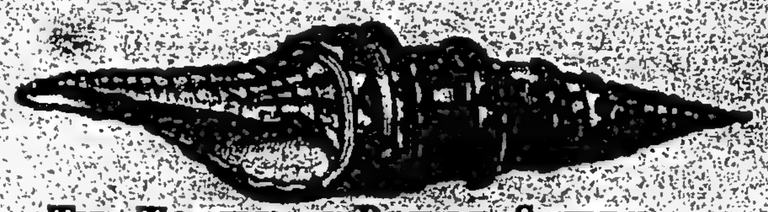
THE CLOUDED OLIVE

THE TULIP SHELL

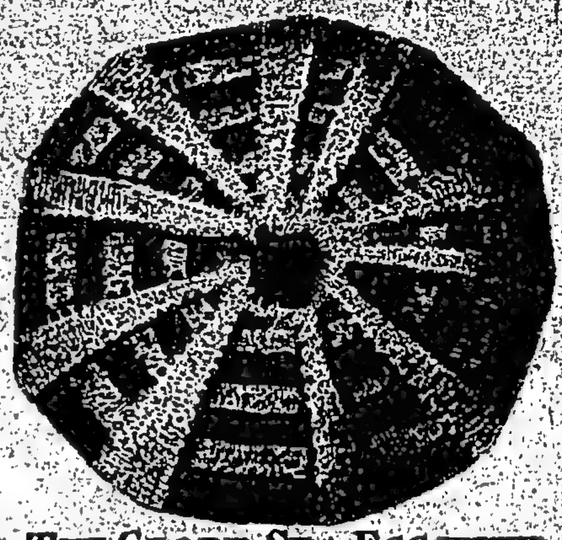
THE PORPHYRY SHELL



THE HIGHBACK'D SEA EGG



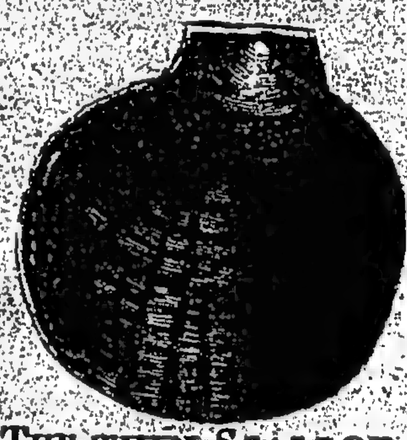
THE TOWER OF BABEL SHELL



THE GLOBE SEA EGG WITH VARIOLATED PAPILLÆ

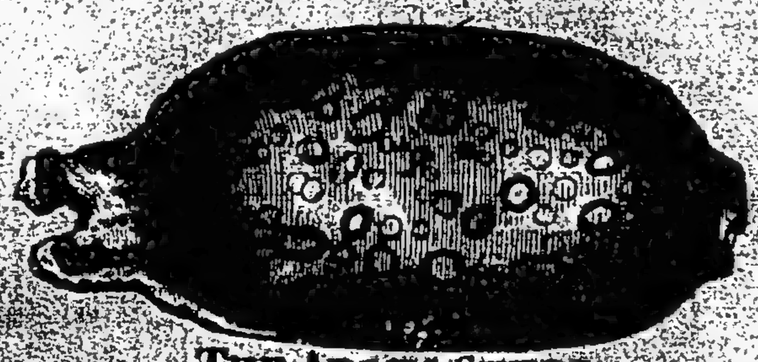
THE ROUGH TROCHUS

THE GREAT PRICKLY OISTER



THE THIN SCALLOP

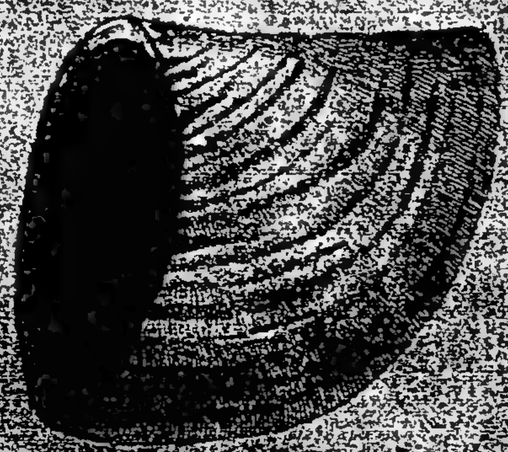
THE CONIC MUSCLE



THE ARGUS SHELL

THE CAROLINA MUSCLE

THE [illegible] RAZOR SHELL



THE SMOOTH EDG'D
TRIPLICATED CHAMA

THE THICK RAZOR SHELL

Published by Robert Sayer at the Kings Arms N°53 Fleet street for Law.

MUREX

Purpura or PURPLE *Fish*

DOLIUM

Porcellana or PORCELLAIN *Shell*

Ostreæ or OYSTER

CHAMA

Mytulus or MUSCLE

PINNA *Marina*

Londons Sold by Alex.r Hogg, at the Kings Arms, N.o 16 Paternoster Row

makes its appearance in the form of a broad belt; and in the centre there is a narrow pointed line of the same colours with the other variegations, which is the character-stroke of this shell. From the verge of this, to the extremity of the shell, the yellow gold colour prevails again. It is brought from the East Indies.

The Vice-Admiral Shell is nearly as beautiful as the former, and is somewhat more than two inches in length, and about an inch in diameter at the head. The clavicle is a little longer than that of the Admiral, and has about ten turns; the ground is of a bright gold colour, with the same variegations as the former, only they have a greater mixture of white. There is a line of gold colour at the head, of the breadth of a straw, below which there is a circular line of the variegations, much of the same breadth. Under this there is a narrower line of yellow, and under that a very broad belt of the variegations. Below this there is another of yellow, as in the Admiral, but without the pointed line. Next to this there is another broad belt of the variegations, and then comes the point of the shell, which is yellow. The False Admiral is by some taken for the true one, but it is not near so valuable.

The Tiger-Shell is scarce, and brought only from the East Indies. Its ground is of a dusky red, sprinkled all over with irregular spots, a little whitish; some of these are oblong, others angular, and indented.

The Yellow Tiger Shell is beautifully variegated with white irregular spots of the size of a pea.

The White Voluta is of a faintish white, variegated with dusky red spots, that are very large, and of irregular figures disposed without any order.

The Crown Imperial Shell is three inches long, and near an inch and a half in diameter at the top. The clavicle is so depressed, that in a front view of the shell it is not to be seen. The head is surrounded with a very beautiful row of tubercles pointed at the ends, and the ground colour is pale, with two broad beautiful belts running round it, the one near the head, and the other towards the other extremity. They are of a fine yellow, prettily variegated with black and white. It is brought from the East Indies, though few of them are quite perfect.

The Hebrew Letter Shell is smaller than the rest of this kind; for it is rarely above an inch and a quarter in length, and three quarters of an inch in diameter at the top. The body is in the shape of a cone, and the clavicle pretty long, with about five turns, but it is blunt at the extremity. The ground colour is of a pearly white, variegated with large irregular black marks, disposed in about four rows on the body, and there is a single row to each turn of the clavicle. Some have fancied they resemble Hebrew letters. It is brought both from the East and West Indies.

The Whitish Voluta, variegated with brown and purplish blue spots, is more than four inches long, and two in diameter at the head, from whence the body tapers very gradually, and is large and blunt at the end. The clavicle consists of seven or eight turns, and is blunt at the extremity; the ground of the shell is white, variegated with spots of different sizes running in circles round it; these circles are from twenty to thirty in number on the shell, some of which are brown, and others of a purplish blue. It is brought from the coast of Guinea.

The Half Crowned Voluta, with an undulated surface, is more like the Crown Imperial than any other shell of this kind. It is about two inches and a half in length, and near an inch and three quarters at the head. The edge of this is deeply indented, so as to form a kind of crown. The colour is white, and the variegations of a faint brown. It is brought from the coast of Africa. To which may be added, the Slender Voluta.

The Butterfly Shell has three very beautiful belts round the body, and one narrower near the head, consisting of large spots of a deeper and paler brown, with some white: they resemble the spots, in the form of eyes, on the wings of some butterflies.

Of LIMPETS.

Limpets are simple shells of a conical, or gibbous shape, with a very wide opening at the bottom; of these are the—Streaked—Starry—Oval Smooth—The Great Oblong—and many other sorts, for which we refer our readers to the plates of Shell-Fish and Shells.

SEA-EAR-SHELLS.

The Haliotis or Ear-Shell is a simple one, of a depressed shape, with a large mouth, having somewhat of a spiral form at top: among this kind are reckoned the—Great Ear—The Long Ear—and the Streaked, or Wrinkled Ear-Shell.

DENTALIA, or TOOTH SHELLS.

Of these are distinguished the Streaked—The Ringed—The Dog-Tooth—Conical—Crooked Streaked, and Ringed; and the Great Sea-Pipe.

Of CYLINDRIC SHELLS.

The Brocade Shell is large and beautiful; the colour being as white as silver, variegated with a bright brown, in fine irregular lines, clouds, and spaces.

The Tulip Cylinder. The colour of this shell is white, variegated with clouds and spots of blue and brown. It is very scarce, and is brought from the East-Indies; but seldom in perfection.

The Porphyry Shell is about two inches and a half long, and an inch and quarter in diameter. The shape is nearly like that of a cylinder, with a short blunt clavicle. The colour is of a pale white, with a reddish cast, clouded with a deeper red approaching to purple, which takes up much the greater surface. This colour appears in most places in irregular longitudinal and dentated lines. It is brought from South America.

The Slender Whitish Cylinder Shell, variegated with brown, is three inches and a half long, and near an inch and quarter in diameter. It is shaped nearly like a cylinder, only it is somewhat smaller towards the point than elsewhere. The clavicle has four or five turns, and the body of the shell is cloven at the other extremity, by the continuation of the mouth. The colour is white, with a broad belt near each end, variegated in such a manner that some have imagined there are letters thereon. It is brought from the East Indies and South America.

The Slender ditto, variegated with brown and white, is three inches long, and about an inch and quarter in diameter. Its shape is nearly like that of a cylinder, only it is a very little smaller at both ends than in the middle. The clavicle is blunt, though it has four or five turns, and the whole shell is variegated with a bright white, and a pale tawny brown. They are disposed in denticulated lines, and the surface appears to be finely polished, it being very bright. It is brought from South America.

Of DOLIA, or PIPE SHELLS.

Pipe Shells are ſo called, from being imagined by ſome to be like the pipes or caſks made to hold wine. However their ſhapes differ ſo much that it may be doubted whether this appellation is proper. In this claſs among others are placed the—Oval Pipe Shell—The Partridge Shell—The Harp Shell—And the Æthiopian Crown. The ſhape of the laſt is oblong, and ſomewhat oval, being ſmaller at each end than in the middle. The mouth is long and wide, and cleaves the extremity of the ſhell a little way. The clavicle is ſhort and blunt at the end, and has four turns; that next the body, as well as the upper edge of the body, are deeply dentated, or as ſome ſay crowned, and the teeth are formed into regular even conical points. The ſurface is pretty ſmooth, only there are impreſſions of longitudinal lines; and the colour is of a pale browniſh yellow. It is brought from Africa and the Eaſt Indies. There are ſome other ſorts of this ſhell, which, for the ſake of brevity, we ſhall omit.

Of PORCELAIN SHELLS.

The porcelain is a ſimple ſhell, conſiſting of one piece gibbous on the back; the mouth is long, narrow, and dentated on each ſide.

The White Porcelain Shell, yellow within and beaked at each end, is of an oblong ſhape and very gibbous. The length, including the beaks, is about three inches, and its diameter in the middle nearly two. It is white on the outſide, and yellow within; and the mouth is large, having a ſort of a ſnout or beak at each end. It is brought from Africa and the Eaſt Indies.

The Argus Shell is about three inches long, two in diameter, and ſomewhat leſs in height, though it is gibbous like the former. The mouth is wide, and the lips are continued at each extremity in the form of a broad ſhort beak each way. The general colour is yellowiſh, only there are three brown bands of a conſiderable breadth running over it; the whole ſurface is adorned with a multitude of round ſpots like eyes, from whence it has its name. It is brought from Africa and the Eaſt Indies.

The Map Shell is about two inches and a half long, and nearly as much in diameter, with a gibbous back. At the head there is a ſhort clavicle, placed a little above the extremity of the mouth, conſiſting of about four imperfect turns. To theſe may be added, the—Bluiſh Banded Porcelain—The Oval Porcelain—The White Porcelain—The Small Pox, and the Beetle.

Of BIVALVED SHELLS.

Of theſe there are ſix kinds, namely, Oyſters, Baſtard Cockles, Muſcles, Heart Shells, among which Common Cockles are included, Scollops, and Razor Shells.

The Hammer Oyſter has one of the moſt extraordinary ſhells in the world, it being in ſhape like a hammer, or rather like a pick-ax, with a very ſhort handle and a long head. The body of the ſhell, which is taken for the handle, is about four inches long, and three quarters of an inch broad; but the head is five or ſix inches long, and except where it joins to the body, is little more than half an inch broad. It is of an irregular form, uneven at the edges, and terminates in a narrow blunt point at each end. The hinge or joint is at the lower end of the body; and the ſhells open all the way from each end to this part, and yet they ſhut very cloſe. The edges of the body and head have often great irregularities and protuberances on the ſurface, being deeply furrowed in all directions.

Under this claſs are included the Beard Oyſter—The Great Prickly—The Conical—The Hedge-Hog, and others; for an account of which ſee page 250 of the Natural Hiſtory. Of Cockles are reckoned the Baſtard—The Truncated Baſtard—The Arabian Shell—The Venus, or Concha Veneris, and the—Oriental Concha Veneris.

Of MUSCLES.

Theſe are compoſed of two valves or ſhells, of a longiſh ſhape, that ſhut all the way, and are both convex. Our ſea and river Muſcles are too well known to need any deſcription.

The Carolina Muſcle is four inches long, and an inch and a half broad.

The Ader is a very curious ſhell, of a fine ſky-blue colour, with yellow rays one over another towards the bottom.

The Anpan has a bivalved ſhell, and is one of the largeſt that is met with at Senegal.

The Pinna Marina is of an olive brown colour on the outſide; but within it is partly of a pearl colour, and partly reddiſh.

The Prickly Pinna is furniſhed with a ſort of ſcales, many of which terminate in prickly points.

To which we may add Heart-ſhells and Cockles, as the—Thin White Heart—The deeply furrowed and Spinous Heart.

Scollop Shells, as the ribbed and variegated—The Red Ribbed and Furrowed—The Ducal Mantle—and the Iriſh Scollop.

Finger Shell Fiſh, as the Thick Red Finger—The crooked Finger—The ſlender, ſtraight Brown and White—and the Violet Purple Finger Shell.

Acorn Shell Fiſh, as the Great Furrowed—The Bell faſhioned—and the Greyiſh-white, Furrowed, Slender Acorn Shell.

Thumb-footed Shell Fiſh, as the Blueiſh Grey—The Reddiſh—and the White.

File Shell Fiſh, or the Pholades, as the longiſh White, Chequered and rough—The White and Weſt Indian Pholas.

Of FRESH WATER SHELL FISH.

The Oval Limpet, with a crooked ſnout, is very thin, oval and depreſſed, except in the middle, where it riſes into a beak. It is no bigger than a man's finger nail, and is found ſticking to ſtones in the brooks of Northamptonſhire.

The roundiſh Target Limpet is ſmaller than the former; and, inſtead of a beak, has a ſort of button at the top. It is very thin and delicate, and has a pretty ſmooth ſurface, of an olive brown colour. It is found in ſome of the rivers of Leiceſterſhire.

The Oval Limpet, with a hole at the top, is a quarter of an inch in diameter, and an eighth in height. The ſhell is very thin, rounded at both ends, and of a duſky brown colour. The hole is ſmall and oblong, and ſeems to be formed of two round holes broken into each other. This is common near London.

The Spiral Snail Shell, with a clavicle a little elevated, and a round mouth, is three quarters of an inch in diameter, and the ſhell is firm, ſolid, and ſmooth at the ſurface. It conſiſts of about four turns, and the clavicle at the center is raiſed above the reſt of the ſurface. The colour is a greyiſh white, and the large turn has a ſtreak of black running along it, but loſes itſelf before it reaches the next turn. It is found in the lakes in the north of England.

INSECTS.

TÆNIÆ

of the Oak

of the Hornbeam

Caderworms & Cases

Papilionaceous Flies of Caderworms

of the Lily & its Beetle

of the Honey comb with their Pipes or Cases

of the Artichoke & its Aurelia

of the Gooseberry

PUCERONS

of the Rose (winged)

of the Elder

of the Peach

of the Rose (naked)

Nat size

of the Lime Tree

of the Beech

Bastard Pucerons & Flies

Puceron-eaters & Flies

of the Fig Tree & Box

Leaf-GALLS & Insects of the Lime Tree

of the Cardinus Hæmorrhoidalis

of the Oak

of the Chamædrys

Nat Size

Magnified

Published by Alex.r Hogg at the Kings Arms N.o 16 Paternoster Row